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ARMSTRONG LABORATORY

LEAD EXPOSURE HAZARD MANAGEMENT GUIDE

Ivette Z. Hermon-Cruz, Captain, USAF, BSC
Catherine L. Fisher, Second Lieutenant, USAF, BSC
Bennett Hibbler, Major, USAF, BSC
Richard L. King, Sergeant, USAF
Daniel R. Turek, Major, USAF, BSC
Edward J. Primeau, Staff Sergeant, USAF
Donald W. Johnson, Sergeant, USAF

OCCUPATIONAL AND ENVIRONMENTAL HEALTH DIRECTORATE
OCCUPATIONAL MEDICINE DIVISION
2402 E Drive
Brooks Air Force Base, TX 78235-5114

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IVETTE Z. HERMON-CRUZ, Capt, USAF, BSC
Consultant, Industrial Hygiene

MARK H. STOKES, Col, USAF, BSC
Chief, Occupational Medicine Division

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Ivette Z. Hermon-Cruz
Catherine L. Fisher
Bennett Hibbler
Richard L. King
Daniel Turek
Edward J. Primeau
Donald W. Johnson

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Armstrong Laboratory (AFMC)
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This report discusses procedures to perform Lead-Based Paint investigations. It is intended to provide practical methods to be used in-house. It describes the roles and responsibilities of the Bioenvironmental Engineer, Military Public Health Officer, the Lead Toxicity Investigation team, and the necessary steps to perform lead-based paint risk assessments and hazard identification. It emphasizes risk assessments as a tool to achieve a lead hazard-free environment instead of a lead-free environment. It is a compilation of the best available information on lead sampling and analysis, medical monitoring, risk assessments, in-place management, worker protection, hazardous waste management, abatement, and cleanup.

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DEFINITIONS

Abatement - Long-term or permanent measures which eliminate the possibility of hazardous exposure by replacement of building components, encapsulation, enclosure, or removal. It includes all preparation, cleanup, disposal, and postabatement clearance testing activities associated with such measures.

Accessible, mouthable surfaces - an interior or exterior surface painted with lead-based paint that is accessible for a young child to mouth or chew.

Accuracy - the degree to which a measurement process determines a known amount of lead or other component in a particular reference material.

Acute effect - severe or immediate reaction, usually to a single large exposure.

Biological monitoring - the analysis of a person's blood and/or urine to determine the level of a contaminant, such as lead, in the body.

Blank - a nonexposed sample of the medium used for testing, such as a wipe or filter, which is analyzed like other samples to determine if samples were contaminated during collection, transportation, or analysis.

Body burden - the total amount of a substance that is deposited in the entire body. Metals, such as lead and mercury, tend to accumulate in the kidneys, the liver, and especially the bones.

Certified contractor - a contractor, inspector, or supervisor who has completed a training program certified by the appropriate Federal agency; and, has met any other requirements for certification or licensure established by such agency or who has been certified by any State through a program which has been found by such Federal agency to be at least as rigorous as the Federal Certification Program. It includes workers or designers who have fully met training requirements established by the appropriate Federal agency.

Chronic effect - a response to exposures which may take days, months, or years to develop.

Common area - a room or area that is accessible to all residents in a multifamily building (e.g., hallway, laundry room).

Comprehensive survey - testing of military family housing and priority facilities for lead-based paint in accordance with the HUD LBP Interim Guidelines for Hazard Identification and Abatement using an X-ray fluorescence spectrum analyzer.

Containment - process for protecting both workers and the environment by controlling exposures to lead dust and debris created during routine maintenance or abatement work.

Detection limit - the minimum amount of a component that a method can reliably measure.

Deteriorated paint - any paint located on an interior or exterior surface or fixture that is damaged, deteriorated, peeling, chipping, chalking, or cracking.

Facilities likely to contain lead-based paint (LBP) - Certain types of paint applied before 1980 are more likely to contain lead. These are oil-based paints used in industrial facilities, on steel structures (water towers, pipelines, etc.), and in yellow airfield and roadway pavement markings. They have excellent sealing (stain resistance) and anticorrosion properties; and they are very durable and resistant to the ultraviolet light in sunlight. They were also applied primarily to kitchens, bathrooms, and interior and exterior wood trim in residences. Latex paint for architectural use, which normally does not contain lead, became popular after 1960 and nearly all paint applied after 1980 to interior and exterior houses and nonindustrial buildings was latex paint. This was reinforced by the Consumer Product Safety Act. However, because of their desirable properties and lack of federal regulation, LBP continued to be used in industrial facilities, on steel structures, and for pavement markings. Additionally, due to the complex wording of the Consumer Product Safety Act, LBP may also be found in nonindustrial facilities, primarily in primers on ferrous metal surfaces.

Final inspection - inspection by a qualified inspector, industrial hygienist, or local public health official to determine whether abatement and cleanup are complete.

Friction surface - an interior or exterior surface that is subject to abrasion or friction, including certain window, floor, and stair surfaces.

High Efficiency Particulate Air (HEPA) Filter - a filter capable of filtering out particles of 0.3 microns or greater from a body of air at 99.97 percent efficiency or greater.

High phosphate detergent - detergent that contains at least 5 percent trisodium phosphate (TSP).

High priority facilities - facilities or portions of facilities which are or may be frequented/used by children under the age of seven. Air Force Policy prioritizes specific facilities as follows: child development centers, annexes, and playground equipment; on-base Air Force licensed family day care home; youth centers; recreational facilities, and playgrounds; waiting areas in medical and dental treatment centers; Air Force-maintained Department of Defense Schools; military family housing (MFH) currently occupied by families with children under age seven; and remaining MFH.

In-place management - a set of measures designed to temporarily reduce human exposure or likely exposure to lead-based paint hazards, involving: specialized cleaning; maintenance, painting, and temporary containment; ongoing monitoring of lead-based paint hazards or potential hazards; and, the establishment and operation of management and resident education programs.

Lead-based paint - paint or other surface coatings that contain lead in excess of limits established under section 302(c) of the Lead-Based Paint Poisoning Prevention Act (LBPPPA). At the time of this publication the LBPPPA defines LBP as paint or other surfaces coatings that contain lead in excess of 1.0 milligrams per square centimeter or 0.5 percent by weight.

Lead-based paint hazard - any condition that causes exposure to lead from lead-contaminated dust, lead-contaminated soil, lead-contaminated paint that is deteriorated or present in accessible surfaces, friction surfaces, or impact surfaces that would result in adverse human health effects as established by the appropriate Federal agency.

Lead Exposure Risk Assessment (LERA) - conducted by a qualified individual, usually the BEE, after an initial survey to further assess LBP hazards in MFH and other high-priority facilities. Includes a detailed review of building construction, painting history, and limited bulk and wipe sampling.

Medical removal - the temporary removal of workers due to elevated blood lead levels.

Multifamily Units - group of apartments, buildings or single units with similar characteristics such as floor plan, construction materials, painting histories, and date of construction.

Precision - the degree of repeatability of a series of successive measurements.

Scattered-Site or Single-Family Units - units that are distinct, with their own unique layout, construction materials, painting, and maintenance history. Child development centers, youth center, and schools usually fall in this category.

Standard deviation - a measure of variability equal to the square root of the arithmetic average of the squares of the deviation from the mean in a frequency distribution.

Worst-case units - housing units that are most likely to have lead hazards accessible to children. Primarily consists of units that are in poor condition or units in which maintenance or renovation work was recently conducted that has disturbed paint and created dust.

Standards and Regulations

1. 16 CFR 1303, Ban of Lead-Containing Paint and Certain Consumer Products Bearing Lead Containing Paint, implementing the Consumer Product Safety Act of 1977: The Consumer Products Safety Act restricted the amount of lead in paints manufactured after 27 February 1978 for sale directly to consumers and in paint to be used in residences, schools, hospitals, parks, playgrounds, public buildings, and other areas where consumers have direct access to painted surfaces (non-industrial facilities). Lead in paint used in industrial facilities is not restricted by federal law. Allowing two more years for stocks to be depleted, it is reasonable to make assumptions concerning the use of LBP in facilities, using 1980 as a transition year.

2. Title 42, U.S.C., Section 4801, et. seq., Lead-Based Paint Poisoning Prevention Act (LBPPPA) of 1971 with four amendments.

3. Federal Register, 18 April 1990, Vol 55, No 75, Department of Housing and Urban Development (HUD), Lead-Based Paint: Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing, as amended, September 1990.

4. 29 CFR 1926.62, Safety and Health Regulations for Construction, and 29 CFR 1910.1025, Occupational Safety and Health Standards, Lead: These standards specify measures to protect workers against hazardous exposure to lead in construction and general industry, respectively. They include the permissible exposure limits, exposure monitoring, engineering, work practice and administrative controls, respiratory protection, protective clothing, housekeeping and hygiene, medical surveillance, employee training, and hazard communication.

5. 40 CFR 50.12, National Primary and Secondary Ambient Air Quality Standards for Lead, contains ambient air quality regulations which may apply to large scale LBP removal projects, primarily those involving large steel structures such as water tanks and bridges. The criteria for lead emissions is 1.5 micrograms per cubic meter, maximum arithmetic mean over 90 days. The assessment is based on an analysis of total suspended particles in air.

6. 40 CFR 240 through 280, implementing the Resource Conservation and Recovery Act (RCRA): RCRA regulations specify that LBP debris is considered a hazardous waste when leachate exceeds 5 parts per million from a 100-gram sample or 5 milligrams per liter by the Toxicity Characteristic Leaching Procedure (TCLP). They also specify transportation, treatment, storage, and disposal requirements.

7. 40 CFR 302, Implementing the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): CERCLA regulations contain notification requirements when toxic hazardous waste is released into the environment. These requirements apply to releases of more than one pound of LBP debris (if it is considered hazardous waste) and particles are less than 4 mil in diameter.

8. AFM 85-3, 15 June 1981, Paints and Protective Coatings: Restrictions on use of LBP.

9. Public Law 102-550, Title X, Residential Lead-Based Paint Exposure Reduction Act of 1992: Amends the LBPPPA and TSCA and requires HUD, EPA, CDC, and Department of Labor to develop standards, guidelines, regulations, and training requirements for LBP activities. It makes the Federal government subject to the same stringent LBP laws and regulations as nongovernment entities, including certification, licensing, record keeping, and the payment of reasonable service charges. The statute requires compliance with all laws dealing with LBP, LBP activities, and LBP hazards, whether the law is a federal, state, interstate, or local law. To permit effective enforcement of this statute, the United States has waived its immunity from lawsuit, subjecting the Federal government to all remedies provided for in the violated federal, state, interstate, or local law.

10. DoD Directive 6050.16, DoD Policy for Establishing and Implementing Environmental Standards at Overseas Installations.

11. 15 U.S ~. 2601 et. seq., The Toxic Substances Control Act (TSCA)

ACRONYMS

AAS	Atomic Absorption Spectrometry
AF	Air Force
AL	Action Level
ALARA	As Low As Reasonably Achievable
ALC	Apparent Lead Concentration
ASTM	American Society for Testing and Materials
BEE	Bioenvironmental Engineer
BCE	Base Civil Engineer
BDAT	Best Demostrated Available Technology
BLL	Blood Lead Level
CE	Civil Engineering
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDC	Child Development Center
CFR	Code of Federal Regulations
CLC	Corrected Lead Concentration
DoD	Department of Defense
E-Mail	Electronic Mail
EPA	Environmental Protection Agency
EBL	Elevated Blood Lead
HEPA	High Efficiency Particle Air Filter
HUD	Department of Housing and Urban Development
ICP-AES	Inductively Coupled Plasma
IAW	In Accordance With
IPM	In-Place Management
JA	Judge Advocate
LBP	Lead-Based Paint
LBPPPA	Lead-Based Paint Poisoning Prevention Act
LERA	Lead Exposure Risk Assessment
LERAQ	Lead Exposure Risk Assessment Questionnaire
LTI	Lead Toxicity Investigations
MFH	Military Family Housing
MPHO	Military Public Health Officer
MTF	Medical Treatment Facility
NIST	National Institute of Standards and Technology
NIOSH	National Institute of Occupational Safety and Health
NLLAP	National Lead Laboratory Accreditation Program
NRC	Nuclear Regulatory Commission
NTL	Not Later Than
OPPT	Office of Pollution Prevention and Toxics
OSHA	Occupational, Safety and Health Administration
PA	Public Affairs
PEL	Permissible Exposure Limit
PPE	Personal Protective Equipment
RCRA	Resource Conservation and Recovery Act
RIC	Radioisotope Committee

RSO	Radiation Safety Officer
SEL	Substrate Equivalent Lead
SG	Medical Treatment Facility Commander
SGP	Chief of Aerospace Medicine
SSAN	Social Security Account Number
STELLAR	Systematic Tracking of Elevated Lead Levels And Remediation
TDY	Temporary Duty
TCLP	Toxicity Characteristic Leaching Procedure
TSCA	Toxic Substances Control Act
TSP	Trisodium phosphate
TWA	Time weighted average
USAEHA	United States Army Environmental Hygiene Agency
U.S.C	United States Code
VOC	Volatile Organic Compound
XRF	X-Ray Fluorescence

SECTION I

INTRODUCTION

Purpose

This technical report provides Bioenvironmental Engineers (BEEs) and Military Public Health Officers (MPHOs) with the tools to effectively manage lead hazards. This report supplements the Air Force Policy and Guidance on Lead-Based Paint (LBP) in Facilities.

Scope

This report discusses procedures to perform LBP investigations. It is intended to provide practical methods to be used in-house. It describes the roles and responsibilities of the BEE, MPHO, the Lead Toxicity Investigations (LTI) team, and the necessary steps to perform LBP risk assessments and hazard identification. It emphasizes risk assessment as a tool to achieve a lead hazard-free environment instead of a lead-free environment. It is a compilation of the best available information on lead sampling and analysis, medical monitoring, risk assessments, in-place management, worker protection, hazardous waste management, abatement, and cleanup. This report contains the most recent information on lead hazards as of the date of publication. The Federal Government is expected to come up with new and updated regulations in the next 6 months. This document will be updated as changes occur.

Background

History of Lead Use

The history of lead use traces back many centuries. World production of lead 4,000 years ago has been estimated at 160 tons per year; 2,700 years ago, it was 10,000 tons per year; and, during the Roman Empire, lead production increased to 80,000 tons per year.

The occupational hazards of lead were first reported in 1713 by Bernardo Ramazzini, who described lead intoxication in potters working with leaded glaze. Later in the 18th century, Benjamin Franklin described the toxic effects of lead occurring in tradesmen who used lead in their occupations.

The favorable physical and chemical properties of lead accounted for its extensive use. Lead can be rolled into sheets which can be made into rods and pipes. It can be molded into containers and mixed with other metallic elements. Lead was used in building construction, especially roofing, cornices, electrical conduits, and water and sewer pipes. Lead compounds such as white lead and lead chromate were widely used as pigments in paint (making up as much as 50% of the dried paint by weight). Lead is also commonly present in varnishes and primers. Many houses built before 1978, and especially those built in 1950 or before, are believed to contain paint with high levels of lead.

Health Effects

The toxic effects of lead on humans beings have been known for many years. Acute overexposure to lead can kill in a matter of days. Chronic overexposure to lead in adults may result in severe damage to the blood forming organs, and the nervous, urinary, and reproductive systems. The frequency and severity of medical symptoms increases with the concentration of lead in the

blood. Many adults with blood lead levels (BLLs) of 80 micrograms per deciliter ($\mu g/dl$) or greater have symptoms or signs of acute lead poisoning; although in some individuals, symptoms may be so mild that they are overlooked. Common symptoms of acute lead poisoning include: loss of appetite; nausea; vomiting; stomach cramps; constipation; difficulty in sleeping; fatigue; moodiness; headache; joint or muscle aches; anemia; and, decreased sexual drive. Long after exposure has ceased, physiological events such as illness or pregnancy may release stored lead from the bone and produce health effects; such as: impaired hemoglobin synthesis; alteration in the central and peripheral nervous systems; hypertension; effects on male and female reproductive systems; and damage to the developing fetus. These health effects may occur at BLLs below 50 $\mu g/dl$. Blood lead levels of workers, both male and female, who intend to have children, should be maintained below 30 $\mu g/dl$.

Lead poisoning is primarily found in young children. It results from the inhalation or ingestion of contaminated lead-based paints/dust, soil, dirt, water, air, etc. Lead provides no physiological purpose; but, once it is ingested or inhaled, it passes to the blood and bone marrow.

Childhood lead poisoning is one of the most common and preventable pediatric health problems in the United States today. Children are particularly susceptible to lead's toxic effects. In 1984, the Agency for Toxic Substances and Disease Registry estimated 17 percent of all American preschool children had BLL exceeding 15 $\mu g/dl$. Because of evidence showing adverse effects at low-blood lead levels, new guidelines titled, "Preventing Lead Poisoning in Young Children," [Centers for Disease Control, October 1991], have lowered the definition of lead poisoning to a BLL greater than or equal to 10 $\mu g/dl$.

Lead injuries in children start even before birth. Fetuses are exposed to lead passed through the placenta from a woman with lead in her system. The effects of lead poisoning on the brain and central nervous system are irreversible and cause delays in emerging cognitive and language development. Umbilical cord blood lead levels of 10 to 15 $\mu g/dl$ appear to be associated with reduced gestational age and reduced birth weight. Fetal exposures to low lead levels have been shown to decrease stature and affects the ability to maintain steady posture.

Young children are more likely to ingest or inhale lead because of their proximity to the floor or ground, and frequent hand to mouth behaviors. Given a certain quantity of lead ingested, a child will absorb approximately 40% compared to 10% in an adult. Elevated blood lead level, with an accompanying iron deficiency, will enhance lead absorption from the GI tract. Children have more trouble than adults in isolating lead in their bones, so a larger fraction of the body burden of lead is available to targeted organs. Developing brains are also more susceptible to the toxic effects of lead. Children develop rapidly in their early years, a time when lead poisoning has its most devastating effects. Symptoms in children include: vomiting, ataxic gait, seizures, aggressive behavior disorders, developmental regression, persistent pica, mental retardation, alterations in consciousness, intractable seizures, and coma.

Current research findings indicate that blood lead levels in children as low as 10 $\mu g/dl$, which do not cause distinctive symptoms, are associated with decreased intelligence. Lead damages the kidneys, central and peripheral nervous system, the hematopoietic system, and causes impairment of the biosynthesis of the active vitamin D metabolite which is detected at blood lead levels of 10 $\mu g/dl$ to 15 $\mu g/dl$. It has been shown that lead poisoned children have lower serum total and ionized calcium levels. Survivors of severe lead poisoning may have severe mental retardation. With lower levels, a child may suffer from developmental delay, a lower IQ, hyperactivity, learning disabilities,

behavioral problems, impaired hearing, and stunted growth. Very high levels of lead can cause seizures, coma, and death.

Sources of Lead in the Environment

LBP is only one of a number of potential sources of lead in the environment that can contribute to lead poisoning. Other sources include emissions from combustion of leaded gasoline, industrial emissions of lead, lead in pipes and soldered joints in plumbing, and lead in food containers. In recent years, the principal industrial use of lead is in the manufacture of electrical storage batteries, ammunition, various chemicals, and sinkers for fishing.

The major source of lead for most adults is occupational exposure. In the Air Force, operations involving potential exposure to lead include maintenance, renovation and abatement work, corrosion control, welding, and cable maintenance operations. Workers who may be exposed to lead include abrasive blasters, inspectors, painters, communication technicians, and welders.

Experts agree there are three major sources of lead exposure in children today: (1) LBP, (2) urban soil and dust and, (3) drinking water. These sources are considered major because many children are generally exposed; other sources can result in high exposures in individual cases. Contributions from other sources add to the problem and are, therefore, of potential concern.

Regulatory Background

Regulatory efforts to reduce use of LBP began in 1971 with the enactment of the Lead-Based Paint Poisoning Prevention Act (LBPPPA). The LBPPPA required housing authorities to conduct random inspections of public and Indian housing. In 1978, the Consumer Product Safety Commission banned the use of paint containing more than 0.06% lead by weight on interior and exterior residential surfaces, toys, and furniture. Further legislation directed the Department of Defense (DoD) to take a more active role in ensuring military dependent children are not affected by LBP hazards. In response to this, DoD issued a policy letter on LBP in Nov 92. This policy required DoD components to develop a LBP risk assessment, screening, and control program. The Air Force (AF) Policy and Guidance on Lead-Based Paint in Facilities and the Child Blood Lead Screening Program implement the AF program.

Action Levels for Paint, Soil, and Dust

Currently, there are no federal health-based standards for lead in paint, soil, and dust. The LBP Hazard Reduction Act of 1992, Title X, requires the Environmental Protection Agency (EPA) to define lead contaminated dust, paint, and soil by April 1994. The action levels used in these guidelines are based on the most current information available.

For lead-in-paint the action level used in these guidelines is the Department of Housing and Urban Development (HUD) abatement criteria of 1.0 mg/cm^2 or 0.5% by weight. This action level will trigger several actions like blood lead testing and in-place management. Due to the inaccuracies of the instrumentation used to measure lead in paint, these guidelines recommend different levels of interpretation of the data obtained. These levels will depend on the number of readings taken, but are intended to provide a high degree of confidence that the readings obtained do not exceed the action level of 1.0 mg/cm^2 or 0.5% by weight.

For lead dust, the action level is the HUD abatement clearance criteria of 200 $\mu g/ft^2$ for floors, 500 $\mu g/ft^2$ for windowsills, and 800 $\mu g/ft^2$ for window wells. Again, until the EPA defines lead contaminated dust, these criteria should be used in all facilities with children under 7 years of age.

As in the case of leaded dust and paint, there are no federal health-based levels for lead in soil; although, the State of Minnesota recently established a risk-based requirement for soil abatement of 300 parts per million (ppm). Until a federal standard is developed, a de facto level of 500 ppm is often accepted as a level of concern for lead in soil. This does not mean that levels exceeding 500 ppm constitute, in and of themselves, an imminent health hazard. Neither should it be inferred that a 500 ppm level is safe, especially in a child's play area.

Surveillance Approach

These guidelines recommend a four-step approach to implementing the LBP program at base-level. The first step consists of starting a blood lead screening program and establishing the Lead Toxicity Investigations Team. Section II discusses the responsibilities of each player at base level. It also provides recommendations on how to start the blood lead screening program.

The second step is to perform visual inspections. Visual inspections are designed to identify areas of deteriorated paint in high priority facilities. Procedures on how to perform visual inspections are included in Section III.

Risk assessments are the third step. The LBP Risk Assessment protocol recommended in Section III is designed to identify areas with the greatest hazard. Risk assessments can be performed in conjunction with visual inspections.

The final step is comprehensive testing. Results from comprehensive testing will help determine future abatement strategies. Comprehensive testing is discussed in Section V.

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SECTION II

MEDICAL CHILDHOOD BLOOD LEAD SURVEILLANCE PROGRAM

Because almost all U.S. children are at risk for lead poisoning (although some children are at higher risk than others), all children should be screened. The screening will identify symptomatic or asymptomatic lead poisoning in children. Military Installations/Bases should establish a childhood blood-lead surveillance program.

Blood Lead Screening Program

Who will be screened?

The primary objective of the blood lead screening program is to screen all children between the ages of 6 months and 7 years[1], in accordance with Centers for Disease Control guidelines. DoD will phase in this blood lead screening program over the next 5 years. Of all babies seen for the 12-month well baby visits (which may range in age from 10-18 months), 20% shall have blood lead levels drawn in the first program year, increasing 20% each year thereafter (this group is randomly selected; e.g., every fifth baby seen for the 12-month well baby visit will receive a blood lead level screen). In addition to this randomly drawn group, there will be babies in for the 12-month visit who are not randomly drawn, but are classified as "high risk" according to the Lead Exposure Risk Assessment Questionnaire (LERAQ) (Table II-1), which will be administered by medical personnel. These high risk children must also have their blood lead levels tested. All other children less than 7 years of age shall have their blood lead levels tested when indicated for clinical reasons.

Conducting a Blood Lead Screening Program

The pediatric provider should first perform an assessment of the patient and educate the parent(s), with the focus primarily on the major preventable sources of high-dose lead poisoning, lead-based paint and take-home exposures from parents' occupations and hobbies. Patients should be told of the potential dangers of peeling lead-based paint, the potential hazards of renovating older (pre 1980) homes, and the need for good work practices if their occupations or hobbies might expose them to lead. Assessment of the risk of lead poisoning should be part of routine pediatric well baby checks, starting at approximately 6-8 months of age and at each regular office visit thereafter. Each child should receive a brief assessment using Table II-1 and the following items 1-10, to determine whether the child is at risk for lead poisoning. The issue of lead poisoning and recommended actions to reduce the risk of environmental exposure should become a consistent component of anticipatory guidance routinely provided at the 12-month well baby checks. The following questions should be asked to assess the child's risk of lead poisoning:

1. Has the child previously had an elevated blood lead level (even if it had returned to an acceptable level in the interim)?

2. Does the child have signs and/or symptoms compatible with lead poisoning, such as: loss of appetite; abdominal cramps; constipation; anemia; apathy; lethargy; or, periodic vomiting?

3. Does the child live in a building where a lead hazard has been found, even in another location?

---

[1]This does not include children 7 years of age and older.

4. Does the child live in, or is he/she a frequent visitor to, housing constructed or renovated before 1980 that is poorly maintained?

5. Does the child live in older housing that is or was being renovated while the child is or was living in or visiting there?

6. Does the child have siblings, housemates, visitors, or playmates who are children with known elevated blood lead levels?

7. Do the child's parents or other household members participate in lead-related occupations or hobbies? This includes those who engage in painting, jewelry making, pottery glazing, stained glass work, antique ceramic doll painting, soldering of metal sculptures, lead smelting, battery manufacture and reclamation, radiator repair, pottery manufacture, automotive machine shop work, electronics (soldering), house or barn paint removal, firing range supervisor or worker, gasoline refining, glass manufacturing using purchased glass, casting bullets, cable stripping, die casting, valve and pipe fittings (except brass items), plumbing fixture fittings and trim (except brass items), and construction (bridge, tunnel, and elevated highway).

8. Does the child live near heavy traffic areas, near hazardous waste sites, solid waste incinerators where lead is a major pollutant, or a lead smelter or processing plant?

9. Does the child have pica or frequent hand-to-mouth activity, such as thumb-sucking? This child might also have had an incidence of an accidental ingestion of another hazardous substance.

10. Does the child fail to thrive or have a history of accidental ingestion of nonedible items?

Based on the Lead Exposure Risk Assessment Questionnaire (Table II-1), which is usually accomplished by a pediatric provider or Military Public Health Officer (MPHO), any child with all "NO" answers is classified "LOW RISK," and any child with at least one "YES" answer is classified as "HIGH RISK" for lead exposure and shall receive additional screening as determined by the appropriate health care provider. The questionnaire will be placed in the child's health record as a part of the well baby visit record. Use a Standard Form (SF) 600 overprint.

Lab personnel will log the child into the blood lead screening program log and draw blood, collect, and ship blood lead specimen to an approved Centers for Disease Control laboratory for analysis. The lab personnel will maintain a log of all pediatric blood-lead tests processed.

Table II-1. Lead Exposure Risk Assessment Questionnaire

Child's Name ______________________

Age ________ Date of Birth ____________

Sponsor's SSAN _______________

Does child live in (circle answer) On-Base or Off-Base Housing?
Address ____

RISK QUESTIONS

Does your child ...

1. Have a brother, sister, housemate or playmate with a confirmed blood lead level?	YES	NO	DON'T KNOW
2. Live in or regularly visit a house, day care center, family child care home, or preschool that was built before 1980 which has chipping or peeling paint, or has had recent or ongoing renovation?	YES	NO	DON'T KNOW
3. Live near an active lead smelter, battery recycling plant or any industry you know that releases lead?	YES	NO	DON'T KNOW
4. Live with an adult whose job or hobby involves exposure to lead.	YES	NO	DON'T KNOW
5. Live in or regularly visit a house or preschool classified at high risk for lead hazards, as identified by a Medical or CE building inspection team?	YES	NO	DON'T KNOW

"DON'T KNOW" response will require a more detailed discussion of the question(s) with the parent(s)!

Treatment Catchment Area ______________________

Completed by ____________________ Date ______________

Reviewed by ____________________ Date ______________

Screening Method

Erythrocyte protoporphyrin (EP) is inadequate because it is not sensitive enough. It will only identify a small percent of the children with blood lead levels from 10 through 25 $\mu g/dl$ and misses many children with blood lead levels at 25 $\mu g/dl$ or greater. Lead analysis must be performed on whole blood specimens in a Centers for Disease Control certified laboratory, using the graphite furnace method "ONLY." Either a venous or capillary blood specimen may be used. Unless contamination of capillary blood samples can be prevented, lead levels should be measured on venous specimens. Contamination of capillary specimens obtained by finger prick can be minimized if trained personnel follow proper technique, see Appendix 1. Elevated blood lead results obtained on capillary specimens should be considered presumptive and must be confirmed using venous blood. The capillary or finger-stick specimens are preferred because they are less traumatic; however, the specific blood specimen required should be determined by the military treatment facility (MTF) staff, keeping in mind the capabilities of the laboratory facility.

What to Do When the Results Return for a Child or Pregnant Mother

1. All specimen results, (elevated blood lead (EBL) level/positive or negative results) are recorded in the medical laboratory log and forwarded to the medical provider requesting the test. The lab will also provide the results of all blood lead levels $\geq$ 10 μg to the MPHO.

2. If the results are negative, the parent(s) will be informed by the medical provider and the MPHO will provide more educational information on lead poisoning.

3. If results are positive (BLL $\geq$ 10 $\mu g/dl$) and the specimen was obtained using the capillary or venous method, you must have a confirmatory blood lead level accomplished using venous specimens, in accordance with the information in Table II-2. The chief of the LTI team and MPHO will be notified immediately of all positive results. If the venous confirmatory specimen is positive, follow Table II-3.

Table II-2. Suggested Timetable for Confirming Capillary Blood Lead Level Result With Venous Blood Lead Measurements

Capillary Blood Lead Level *($\mu g/dl$)	Time Within Which Blood-Lead Level Should Be Obtained
$\leq$ 10	Not Applicable
10-19	Within 1 Month
20-44	Within 1 Week
45-69	Within 48 Hours
$\geq$70	Immediately

* $\mu g/dl$ = micrograms per deciliter

Table II-3. Classification and Recommended Actions Based on Confirmed Venous Blood Lead Measurements

Class	Blood Lead	Actions
I	≤ 9	- "low risk"(A): No specific follow-up - "high risk"(B): Consider rescreening 6 months
II	10 - 19	- Reassess risk factors for exposure - Provide education concerning diet and personal hygiene - If level persists (initial test, confirm test, and test 3 months after the confirmation), initiate individual case management, environmental investigation, and lead hazard abatement - Rescreen every 3 months
III	20 - 44	- Complete medical evaluation - Thorough environmental assessment with remediation - Rescreen as indicated by treatment plan
IV	45 - 69	- Begin expeditious medical treatment - Lab must notify responsible physician & MPHO immediately - Thorough and expeditious environmental assessment with remediation
V	≥ 70	- Initiate medical treatment immediately - Lab must notify responsible physician & MPHO immediately - Thorough and expeditious environmental assessment with remediation

(A) "Risk" is assessed via clinical judgment and the information provided by the screening questionnaire (Table II-1).
(B) If 3 consecutive measurements are 10-19 μg/dl, increase interval of measurement to every 6 months.

Installation (Base) Lead Toxicity Investigations (LTI) Team Makeup and Duties

All installations should have a team consisting of, but not limited to, MTF Commander (MTF/SG), Pediatric Clinic (Peds), Chief of Aerospace Medicine (SGP), Military Public Health Officer (MPHO), Bioenvironmental Engineering (BEE), Base Public Affairs (PA), Judge Advocate (JA), Base Civil Engineering (CE), Clinical Laboratory, Base Housing Personnel, and others as deemed necessary.

1. MTF Commander (SG):

a. Develops a blood lead surveillance program using Centers for Disease Control guidelines, "Preventing Lead Poisoning in Young Children"; DOD Policy Letter on Lead-Based Paint, 24 Nov

92; and, AF Child Blood Lead Screening Program dated 2 Apr 93. Other current guidance may also be used.

b. Ensures a system is in place to evaluate and follow-up all children having a positive blood lead level test (blood lead level of 10μg/dl or greater).

c. Appoints a team chief for the Lead Toxicity Investigation (LTI) Team, normally SGP. Other possible team chiefs may be Chief of Peds or Chief of Family Practice.

2. Chief, LTI Team:

a. Ensures all appropriate members are notified about any child with positive/elevated blood lead levels greater than 10 μg/dl. The LTI team chief along with Peds and/or other medical provider(s), will ensure all patients with levels greater than 9 μg/dl are evaluated and scheduled for the appropriate follow-up. The LTI team chief, MPHO, and laboratory officer may track all patients suspected or identified as having elevated blood lead levels by using Centers for Disease Control's Systematic Tracking of Elevated Lead Levels And Remediation (STELLAR)[2] software program.

b. Conducts lead exposure prevention risk assessment (determining the risk of facilities causing lead poisoning in children and how to eliminate the hazard).

c. Initiates a lead toxicity investigation for any child with elevated blood lead level (results greater than 9 μg/dl).

3. Aerospace Medicine (SGP): Ensures a coordinated epidemiological analysis of facility lead sampling and positive pediatric lead screening results is accomplished (BEE & MPHO should work closely to determine the relationship between a child with elevated blood lead level and the source of contamination).

4. MPHO:

a. Investigates incidents of possible lead exposure and ensures follow-up screening is conducted on all children under 7 years of age epidemiologically associated with index cases.

b. Provides lead exposure awareness and prevention education (Appendixes 2 & 3).

c. Prepares Lead Toxicity Investigation (LTI) Narrative Summary: Prepares and forwards a concise LTI narrative summary (usually no longer than one page) for each LTI. Submits this summary to the MAJCOM Military Public Health Officer as soon as possible following the conclusion of the investigation. Whenever possible, use electronic mail (E-MAIL) to ensure timely transmission of narrative summaries.

[2] STELLAR is a FREE program which can be obtained along with copies of Centers for Disease Control's guidelines, "Preventing Lead Poisoning in Young Children," by calling or writing the Centers for Disease Control Lead Poisoning Prevention Branch at 4770 Buford Highway NE, Building 101, Mail Stop F42, Atlanta GA 30341-3724 or call 404-488-7330, fax 404-488-7335.

d. Prepares the Quarterly Blood Lead Level Report: MPHO will use MTF laboratory's log as a source of data for the quarterly Blood-Lead Level Report. MPHO will submit this report to their MAJCOM Military Public Health Officer NLT 10 working days following the end of each calendar quarter using the report format in Table II-4. This report should only include a child's clinical follow-up tests.

e. Report on the number of children screened by catchment area, by age category, by lead level, and by type of housing; i.e., on or off-base as shown in Table II-4.

5. MTF Laboratory (Lab):

a. Draw, collect, and ship blood lead specimens to an approved blood lead laboratory for analyses.

b. Maintain a log of all pediatric blood-lead tests processed. The minimum data elements of this log will be the patient's name, sponsor's SSAN (including "Especially" family member prefix), age, home address and location (on-base/off-base), date the test was processed, and the test result in $\mu g/dl$. The Centers for Disease Control STELLAR program may be used. **Adding the child's address will assist in the epidemiology investigations.**

6. Chief, Pediatric Clinic (and/or the Chief, Family Practice, if well baby checks are conducted there):

a. Appoints a physician to be the medical point of contact for the clinical program.

b. Provides lead exposure prevention information during well baby care.

c. Ensures questionnaires for lead exposure risk assessment are accomplished.

d. Establishes procedures for screening 1-year-old well babies and high risk children less than 7 years of age.

e. Conducts appropriate follow-up for high risk children and for any child with an elevated blood lead level.

f. Provides patient medical evaluations, follow-up, risk assessments, and information on the potential hazards of lead to the parents.

7. Bioenvironmental Engineering (BEE): In cooperation with CE, provides base-wide risk assessment surveys to detect buildings having lead-based paint hazards and recommends abatement and precautionary actions to the appropriate authority.

8. Base Housing: Coordinates with CE and the medical community in removing any lead-based paint hazards that may exist in family or temporary quarters.

9. Public Affairs (PA): Assists base agencies in educating and disseminating information to the base and community population on blood lead issues.

10. Judge Advocate (JA): Provides legal assistance to base agencies addressing blood lead issues.

11. CE Responsibilities:

a. During a LTI this office shall provide information on any demolition, renovation, and maintenance activities on the base that may be disturbing or creating a potential lead hazard. Concentrate on those areas that the child frequents.

b. Act on BEE recommendations to abate LBP hazards and prevent lead exposures.

Table II-4. Blood Lead Level Reporting Form

REPORTING PERIOD: ____________________

CATCHMENT AREA: ______________________

HOUSING	AGE		BLOOD	LEAD	LEVELS	
		< 10	10 - 19	20 - 44	45 - 69	> 70
ON BASE						
	0 - 2					
	2 - 4					
	4 - 6					
	> 6					
OFF BASE						
	0 - 2					
	2 - 4					
	4 - 6					
	> 6					

Note: If a child turns either 2, 4, or 6 years old on the day of testing, the child is counted in the older category; i.e., a child turning 2 on the day of testing is counted in the 2 - 4 category.

Lead Toxicity Investigation (LTI)

EBLs indicate that the patient (child) has been or is currently being exposed to lead somewhere in his or her environment. Without a properly executed LTI, the exposure may continue and cause severe health problems. The primary purpose of an LTI is to identify the source of lead exposure to the affected patient/other family members. If exposure is identified, either remediate the problem or remove the child from the affected area and relocate him/her into an environment that is known to be free of lead hazards. The family will be moved at DoD expense, when living in government owned quarters. The chief of the LTI team will assess the severity of the EBL and determine the appropriate medical treatment. Recommended procedures for conducting an LTI are:

1. Notify LTI team chief of the EBL in a child less than 7 years old and he/she will convene the team members.

2. The team chief will notify the family and inform them that an LTI is in progress because of test results of their child and of any immediate medical treatment needed.

3. The MPHO will conduct a family interview:

Interview the family for details on the child's normal daily routine, where is the child during the day, and any unusual activities that the child may have been involved with over the last couple of weeks or months. Interview the child's parent(s). If old enough, the child should also participate in answering the following questions:

- - What does a typical weekday consist of for the child? Where does he/she go and do?
- - What is a typical weekend for the child?
- - Where does the child go to school/day care?
- - Discuss the child's diet.
- - Any exposure to painting or renovation activities since the last checkup?
- - Has the child participated in any new activities?
- - Any unusual behavior or problems in school?
- - Any indications of chewing on painted surfaces?

4. Hazard Evaluation:

The LTI team will perform a hazard evaluation to determine the source of lead in the child's environment. The type of evaluation will depend on the level of lead in the child's blood and should include one or more of the following actions: records review, risk assessment, comprehensive testing, and parents interview. The LTI team will summarize investigation activities and findings and present them to the team chief.

5. Corrective Action: The LTI team chief will recommend corrective actions to the installation commander, such as: isolate obvious hazard areas where peeling paint is evident; relocate the family to a "safe unit" if contamination within the home appears to be widespread; remediate obvious hazards such as peeling paint (in some cases, extensive abatement might be required); conduct wipe samples after abatement to ensure units have been adequately cleaned; and, recommend the Pediatric Clinic conduct testing on children who may have been exposed in a similar manner.

6. Follow-Up Activities: Information gathered during the LTI will be presented to the team chief and will identify likely sources of exposure. Once identified, the LTI team should:

a. Secure the problem areas immediately and remediate the obvious hazards;

b. If a problem is much larger (for example, if an entire house shows signs of contamination from a renovation project), relocate the family into temporary living quarters that have been identified as being safe from health hazards;

c. If a home has a contamination problem, check furniture and other belongings for lead. Do not move contaminated materials with family;

d. After corrective actions (abatement, in-place management, cleanup, etc.) are complete, the family may return.

7. Reevaluation and Modification of the Screening Program

The Centers for Disease Control recommends universal screening, except in communities/military installations where large numbers or percentages of children have been screened and found not to have lead poisoning. Each military installation shall periodically reevaluate records and reports of pediatric lead screening and modify their programs to meet the specific needs of their communities/military installation. Communities that have large percentages of children without lead poisoning problems can suspend the universal screening PROGRAM by submitting a letter of request, to their MAJCOM. The MAJCOM will indorse and forward the request to HQ AFMOA/SGP for approval. When approval is GIVEN or DENIED, this information will flow from HQ AFMOA/SGP down through the chain of command.

References

Centers for Disease Control. Preventing Lead Poisoning in Young Children. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control. October 1991

Department of the Air Force. Air Education and Training Command (AETC). Lead-Based Paint Management Plan. Draft. March 1993

Department of the Air Force. Headquarters United States Air Force. Child Blood Lead Screening Program. 2 Apr 93

Office of the Secretary of Defense. Lead-Based Paint (LBP) - Risk Assessment, Associated Health Risk in Children, and Control of Hazards in DoD Housing and Related Structures. 24 May 92

SECTION III

LEAD SAMPLING AND ANALYSIS

There are several types of methods used in the identification of lead in paint. These methods can be separated into two distinct types, laboratory analysis of bulk samples and portable field test units/kits, each having unique assets and limitations (Table III-1).

Laboratory Analysis

The most accurate detection method is laboratory analysis. This method requires a paint chip, measuring a minimum of one square inch (consult contract laboratory for recommended size), be removed from the surface in question and submitted for analysis at a laboratory participating in the National Lead Laboratory Accreditation Program (NLLAP). The EPA Office of Pollution Prevention and Toxics (OPPT) has established the NLLAP to recognize laboratory accrediting agencies, such as the American Association for Laboratory Accreditation and the American Industrial Hygiene Association, as competent to certify lead laboratories. NLLAP has been established in order to assure the public that laboratories which participate successfully are capable of analyzing for lead in paint, dust, and soil samples at the levels of concern. A list of such laboratories is available from the EPA National Lead Information Center, (202)260-2080.

The paint chip samples are analyzed in a controlled environment using highly specialized and sophisticated techniques such as Atomic Absorption Spectrometry (AAS) and Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES). Results may be reported in weight per area (mg/cm^2) or weight percent, which are not equivalent due to the varying density and thickness of paint. This method offers extremely accurate results; however, it is very costly ($20 - 40 per sample), time consuming, and cannot provide the confidence necessary to characterize the lead content in a facility unless a chip sample is collected from every surface.

Qualitative On-Site Testing

Chemical Spot Test Kits

Test kits use a chemical reaction to provide qualitative results. Sodium sulfide or sodium rhodizonate is used to cause either a black or dark grey or a blue or scarlet color change respectively, when lead is present. While this method of field testing is significantly less expensive ($1 per sample) than laboratory analysis, it does have several limitations: results are not quantitative, it damages the surface being tested; and, it cannot be used with reddish paint because sodium rhodizonate causes a scarlet color change. Barium and calcium ions in some plaster may also interfere with the test reaction. Potential sources of error include: insufficient sample contact with the indicator solution; user inability to detect weak color changes; allowing insufficient developing time; use on paint film which is too thick (dilutes the lead concentration); and, chemical interferences which cause false positive or false negative reactions.

Currently, we recommend the use of these kits only when performing routine maintenance activities that have the potential to disturb paint and a quantitative test is not feasible. Workers using these kits should be trained on their use and limitations.

Solvent Resistance Test

Paint or polymer can be separated into generic types due to the variation in resistance to solvent spot tests. The following procedure will also provide a qualitative means of determining the presence of lead in paint.

1. Latex paints, which normally do not contain lead, soften in alcohols. Other paints do not.

2. Alkyds and oleoresinous paints (enamels, trim paints, exterior house paints) soften in methyl ethyl ketone. They are the binders most often used for LBP.

3. Epoxy and polyurethane paints do not soften in alcohols and methyl ethyl ketone. They may contain lead pigments.

Precautions must be taken in the preceding methods to protect facility occupants, workers, and the environment when disturbing LBP. Both methods require destruction of the painted surface to some degree and the worker should follow applicable abatement procedures when performing these methods.

Quantitative On-Site Testing

Field X-ray fluorescence (XRF) test units are the preferred method of analysis; due, in part, to their portability and accuracy. These units allow an individual to inspect a facility both qualitatively and quantitatively while significantly reducing the possibility of having to remove paint samples. The results are obtained relatively quickly and usually have a precision of +/- 0.3 mg/cm^2.[3]

Theory and Type of XRF

X-ray fluorescence is defined as exciting an atom with gamma rays causing the excited atom to give off its characteristic (frequency) X-rays by fluorescence. Fluorescence can be defined as the emission of electromagnetic waves of an unstable atom as it stabilizes; i.e., as electrons change orbital fields. XRF instruments currently available contain the radioisotope Cobalt 57 (Co^{57}) which generates the photons necessary to cause lead atoms to fluoresce. The lead atoms then emit unique characteristic photons which are measured with an internal silicon detector. The number of emissions are totaled over a specified time indicating the number of lead atoms within a known area.

XRF instrumentation is available in two measuring categories. Instrumentation is categorized by whether it is single or multifrequency distinguishing. These categories are called direct-read and spectrum analyzers. Direct-reading instruments cannot distinguish between lead atom emissions and those that may emulate lead atom characteristics. This obstacle can be overcome by correcting for or avoiding interfering factors that may affect reading accuracy. During proper usage, direct-read devices maintain respectable accuracy while providing low cost and simplistic operation.

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[3]MAP-3 Spectrum Analyzer only. Precision will vary according to age of radioisotope, survey time, manufacturer's specifications, and substrate effects.

Spectrum analyzers are very similar to direct-read; however, the sensor and programming make it possible for the operator to set specific frequencies to measure and record. This multifrequency function assists the user in determining whether the reading was biased by interfering materials or factors.

The XRF spectrum analyzer unit is equipped with a display that will provide a spectrum graph of the sample and indicate the prominent frequencies. With this information, the operator can make a reasonably sound decision as to the lead content of the painted surface.

XRF Spectrum Analyzer

Air Force Guidance on Lead-Based Paint in Facilities, paragraph 9.a., specifies that XRF spectrum analyzer technology will be used in the identification of LBP in facilities. Thus, the following information will reflect the use and operations of currently available XRF spectrum analyzers. For information on the use and operation of direct-read units, refer to Lead-Based Paint: Interim Guidelines for Hazard Identification and Abatement on Public and Indian Housing, Chapter 4.

Currently there is only one XRF meter with spectrum analyzer capabilities available. This unit, the MAP Spectrum Analyzer, is manufactured by Scitec Corporation. The recommendations set forth in this report are established solely on the current availability of XRF spectrum analyzers and their precision, and do not necessarily indicate indorsement of any product. As new technology and other manufacturers become available, amendments to current policy or this report may be implemented.

The Scitec's XRF Spectrum Analyzer is configured to measure the "K" and "L" shell x-ray emission lines of lead. The K shell line, or higher energy emmission, is normally used for paint analysis because it measures lead in all layers of the paint films. L shell x-rays are attenuated by paint film matrices. Thus, measurement of the L shell x-ray is useful for surface film analysis only.

Operation

The information presented in the next two sections is a digest of the Scitec XRF spectrum analyzer operating instructions. All users of the Scitec instrument must meet USAF radioactive material permit training requirements through the manufacturer or the School of Aerospace Medicine (USAFSAM), and read and become familiar with the manufacturer's operations manual.

The spectrum analyzer consists of a sensor used to test the paint sample, a control console used to operate the sensor, and a battery charger and cables. The inspector should check the condition of the batteries before taking any measurements. The console keypad controls all operations of the instrument. There are 10 numeric keys, a decimal point, a CLEAR key, and an ENTER key.

To begin an analysis, press ASSAY (key #2). The console display will change to the test menu. The analysis time (the time for which the instrument is counting X-rays emitted by the lead in the paint) is selected by the inspector. This is extremely important, because, as discussed below, the precision of the measurement increases with the analysis time. That is, the longer the test, the more precise the measurement. With the pressure of completing testing on schedule, some inspectors may be tempted to reduce the analysis time in order to speed up the work. Unfortunately, this will degrade the quality of the testing data and may lead to incorrect decisions on abatement.

Table III-1. Testing and Analysis Methods Summary

Possible Lead Sources	Activities that Require Sampling	Sampling Method	Action Levels	Advantages	Limitations
Paint	1. Lead risk assessments 2. Maintenance and operations planning 3. Renovation or demolition planning	XRF-Direct reading	positive >1.6 mg/cm^2 negative <0.5 mg/cm^2 $0.5 <$ inconclusive < 1.6 mg/cm^2	-rapid -cost-effective -less destructive	- instrument cost $10-25,000 -skilled, trained operator -radiation safety and monitoring -lab confirmation required
		XRF-Spectrum analyzer	Visual inspections: 0.3 mg/cm^2 TEST mode 0.5 mg/cm^2 CONF mode Comprehensive surveys: positive > 1.3 mg/cm^2 negative ≤ 0.7 mg/cm^2 $0.7 <$ inconclusive < 1.3 mg/cm^2		
		Bulk sampling and AAS, ICP-AES, or GFAA analysis	0.5% by weight (5000ppm) or 1.0mg/cm^2	-superior accuracy -low individual sample cost($20-40) -modest sampler skill	-destructive -long turnaround time -labor intensive -cost prohibitive for large projects
		Chemical spot tests	qualitative only-yes or no for lead present	-low cost ($1.00/test) -modest sampler skill -may be useful for screening	-accuracy/precision not validated -does not quantitate lead -can't use with reddish paint -interference by some plasters
Dust	1. Lead risk assessments 2. EBL child investigations 3. LBP abatement monitoring	Wipe Sampling, Vacuum Sampling, and AAS, ICPAES, or GFAA analysis	Floor-200 μg/sq ft Windowsill-500 μg/sq ft Window Well-800 μg/sq ft	-measures lead accessible for ingestion or inhalation -modest sampler skill -measure of completeness of abatement	-semi-quantitative -results inconsistent with varying technique -difficult to get adequate sample size -characteristics and behavior of lead dust is variable
Soil	1. Lead risk assessments 2. Risk assessment of children's outdoor play areas and gardens 3. LBP abatement monitoring	Composite soil sampling and AAS, ICPAES, or GFAA analysis	>500 ppm	-indicator of direct contact hazard for children -indicator of source of tracked interior lead dust -measure of effect of lead abatement on soil lead levels -modest sampler skill	-soil lead levels highly variable-results inconsistent -estimates of hazard from direct soil contact and soil track are difficult
Air	1. Monitoring of worker exposure during abatement work 2. Monitoring of lead abatement methods 3. Monitoring of lead abatement engineering controls	Personal or area air sample	Permissible Exposure Limit 50 μg/m^3 8 hr time-weighted average (TWA) Action Level: 30 μg/m^3 8 hr TWA	-recognized method -provides quantitation of worker exposure and basis for respirator selection -useful in evaluating abatement methods and hazard controls	-not useful in lead risk assessment in housing -does not measure lead surface contamination and worker or occupant ingestion and inhalation hazard

There are three preset analysis times: Screen (key #2), Test (key #3), and Confirm (key #4). In addition, the operator may manually select the analysis time by pressing MAN (key #5). This is not recommended for normal testing environments, since the analysis time for SCREEN, TEST, and CONFIRM is automatically adjusted by the system's software to compensate for the age of the source, thus maintaining a constant precision of measurement. By contrast, the precision of a measurement in the MAN mode will vary with the age of the source, and will therefore be difficult to interpret correctly.

The analysis times, with a 40 millicurie (mCi) Co^{57} source, are 15 seconds for Screen, 60 seconds for TEST, and 240 seconds for CONFIRM. Other things being equal, the precision of the measurement is proportional to the square root of the analysis time. Thus, since TEST is 4 times longer than SCREEN, the instrument should be twice as precise in TEST mode as in SCREEN mode. Likewise, CONFIRM should be twice as precise as TEST, and 4 times as precise as SCREEN. The manufacturer's operations manual provides a complicated, phased procedure for testing paint against the HUD standard of 1.0 mg/cm^2. This procedure involves first testing in SCREEN mode, proceeding to TEST mode if the SCREEN measurement is in a certain range, and proceeding further to CONFIRM mode is the TEST result is within a different range. Finally, based on further rules, a laboratory test of the paint may be ordered. <u>THESE GUIDELINES PRESCRIBE A DIFFERENT SET OF PROCEDURES FOR XRF TESTING, LABORATORY CONFIRMATION, AND ABATEMENT DECISIONS, AND SHOULD BE FOLLOWED IN PREFERENCE TO THE MANUFACTURER'S INSTRUCTIONS</u>. First, to ensure adequate precision, <u>all testing must be performed in the TEST (60 seconds for a new source) mode</u> except when performing a visual inspection. Second, the classification and decision rules for multifamily and scattered-site testing, as discussed later in this chapter, must be followed in order to make decisions on further testing, laboratory confirmation, or abatement.

Once the analysis time is selected, the measurement is taken by placing the sensor flush against the sample and turning the shutter key to ON. The manufacturer stated no upper limit for the lead concentration which can be measured with the instrument. Several measurement conditions which may be encountered in the field can seriously affect the accuracy and precision of the spectrum analyzer. Rough or uneven surfaces change the total paint area exposed to energy from the source. Since the instrument is calibrated on an area basis, readings taken on curved or irregular surfaces are generally not accurate. For best results, XRF instruments of any kind should not be used on such surfaces. Instead, laboratory testing is recommended.

Improper orientations of the sensor can also introduce biases into the results. The front face plate of the sensor should always be placed flush against the surface of the sample being tested. Also, a test location with sufficient flat area to accommodate this requirement must be selected. If this is impossible, take a sample for laboratory analysis.

Extreme temperature conditions can dramatically degrade the performance of the spectrum analyzer. In particular, the instrument should not be used if the temperature exceeds 110 degrees Fahrenheit. Also, the instrument should not be stored in the interior of a car during the summer. Use the trunk instead. If an instrument <u>has</u> been stored in a hot car interior, be aware that its performance will likely be very erratic. Allow sufficient time for the analyzer to cool down before any testing is attempted.

<u>Radiation Safety</u>

The Scitec MAP Spectrum Analyzer contains 40 mCi of Co^{57}. This radioactive source emits ionizing radiation which presents a biological hazard. It is, therefore, important that these units be used with the appropriate safety procedures.

The USAF Radioisotope Committee (RIC), HQ AFMOA/SGPR, 8901 18th St., Brooks AFB, TX 78235-5217, regulates, by authority of its Nuclear Regulatory Commission (NRC) Broad Scope License (Master Materials License number 42-23539-01AF), aspects of licensing, possession, use, storage, handling, transfer, and disposal of byproduct, source, and special nuclear material in the Air Force, and acts as the single point of Air Force contact with the NRC. Although Co^{57} is not regulated by the NRC, the isotope is regulated by the USAF RIC under authority of AFR 161-16. The USAF RIC identifies permit Radiation Safety Officers (RSOs) by name as one of the listed conditions of a USAF radioactive material permit. Permit RSOs ensure that during daily operations (the receipt, possession, distribution, use, transfer, and disposal of radioactive materials) are according to approved procedures and the specific conditions of the permit and directives.

Procurement

No person or organization may procure a lead analyzer, which contains a radioactive source, without a permit. Procurement activities must follow requirements of AFRs 67-8 and 161-16 for acquiring commodities containing radioactive material. Acceptance of radioactive material into the inventory through reference to the US Air Force Master Materials License by any person or organization other that than USAF RIC is specifically prohibited without prior written authorization of the committee. Acceptance onto an Air Force installation, or into the Air Force inventory, of a lead analyzer containing radioactive materials, obtained through local purchase, local lending or lease agreements requires a USAF radioactive material permit for the material and the written approval of both the named RSO on the permit and the using organization commander.

Procedures for obtaining permits, amendments, and renewals are covered in AFR 161-16. All applications should be submitted through the host base BEE and the MAJCOM BEE, to the Executive Secretary, USAF RIC, HQ AFMOA/SGPR. Refer to Appendix 4 and AFR 161-16 for further procedures for obtaining permits through the USAF RIC.

Shipping and Transportation

The Scitec lead analyzer may qualify as an "Instrument and Article" as listed in Title 49 CFR 173, section 422, provided specific activity and exposure rate limits on the item and the entire package are met. Personnel should reference this document to ensure compliance prior to shipping the instrument. This guidance will assist you in packaging the instrument for source exchange and for transporting to an authorized TDY location.

Most of the Scitec instruments purchased under the Air Force central buy will not be purchased with the optional lead-lined carrying case. If you wish to transport the Scitec device (e.g., remote sites, support sites, etc.), you must purchase the optional carrying case or label the existing case and shipping box according to label requirements from 49 CFR 173. Transportation requirements must be met if the instrument is being transported on public roads and highways, even if transportation is by an Air Force personnel in an Air Force vehicle.

Receiving

Upon receipt of a lead analyzer which contains the Co^{57} radioactive source, at its predetermined receiving point, an individual who has been trained in the proper package receipt procedures regarding radiation safety must be on hand to ensure procedures in 10 CFR 20.1906 are met. The

monitor checks the radiation intensity of the exterior of the package for removable contamination within 3 hours of receipt and inspects it for damage or tampering. Only personnel who have radiation safety training on receiving radioactive material are authorized to open the package. The RSO is to be contacted when shipments are damaged, seals broken or tampered with, or removable contamination in excess of acceptable limits is found. It may also be necessary to detain the carrier to help determine the cause of the discrepancies and check the vehicle for contamination. The monitor then completes and affixes AFTO Form 9B, Radioactive Material Warning Labels, to the package. It is very important to use the AFTO Form 9B correctly. Write in the exact isotope or isotopes, the activity in millicuries (which will often take some conversions) and the date the activity was determined. For instance, a device containing 40 mCi of Co^{57} is stamped with the manufacture date of 18 January 1993, this is the date that goes on the form. Sufficient AFTO Forms 9B must be affixed to a package, so that one is visible from any direction of approach, but only one of the forms must be filled in.

Storage

The Scitec lead analyzer may be stored in unrestricted areas provided the radiation intensity at 1 meter from any single container in storage configuration does not exceed 2 mR/hr and the individual containers are properly identified in accordance with paragraph 14c(2) of T.O. 00-110N-3. Provisions must be made to preclude unauthorized removal of radioactive materials or items. A sufficient number of AFTO Forms 9B will be affixed so that at least one is visible from the direction of approach. Unrestricted storage areas must be surveyed annually to ensure that the limits for an unrestricted area are not exceeded.

Leak Testing

Although sealed sources are designed to prevent the release and dispersal of radioactive material, they sometimes leak. Therefore leak testing is required for the Co^{57} source at least every 6 months. This can be accomplished in-house by the RSO or by the manufacturer under the maintenance contract. Use a dry filter paper disc of 1 3/4 inch diameter or less and ensure you indicate which side of the swipe you used for the survey. Swab the entire aperture and end window area of the source averaging 100 square centimeters per swipe. Disposable gloves should be worn while swiping the source. After swiping, survey the filter with an AN/PDR-27 or equivalent. Allow no further use of the source until advised by the RSO whenever the AN/PDR-27 reading is more than 0.1 mR/hr above background radiation. Place the filter disc in an unsealed AF Form 495, Swipe Container. Fill out the organization name and address and the name and the DSN number of the person who performed the leak test. List either the specific isotope to check for or the types of analyses to be done on the sample. Also include your local sample number, the serial number of the source or set containing it, and a specific description of where the sample was taken. Place the AF Form 495 in a regular envelope and mail it to AL/OEBA, 2402 E Drive, Brooks AFB, TX 78235-5114. Any item that has leak results indicating a removable activity of 0.005 microcuries (5 nanocuries) or more must be removed from service. Immediately notify the USAF RIC. Wrap in plastic and secure to prevent spread of contamination. Contact the manufacturer for return instructions or dispose of as radioactive waste. Notify the Radioisotope Committee of such results as well. Keep all leak test reports on file for examination by authorized persons.

Handling

The Scitec lead analyzers must only be used by, or under the supervision of, individuals who have completed the Scitec Corporation Safety and Handling course or the course conducted by the USAF School of Aerospace Medicine (USAFSAM) and approved by the USAF RIC. Permit RSOs must also attend either the Scitec course or the USAFSAM course. (Note: For other than Scitec devices, users and permit RSO must attend the training course given by the particular device manufacturer. The USAFSAM course is not applicable to other than Scitec devices.) RSOs will be authorized to train users at base level provided that the RSO submits an outline, of how they will train the users, with the permit application. Unauthorized personnel must not be given access to the analyzers nor are they allowed within controlled areas while the source is exposed. All authorized personnel must ensure that work practices are designed to comply with the As Low As Reasonably Achievable (ALARA) principle. The instruments should be kept in the manufacturer's original storage and shipping container while the sources are installed and when the unit is not being used. Strict accountability and control of radioactive materials is essential in preventing loss, theft, and needless exposure.

Additional measures to keep exposures ALARA are:

1. Avoid direct contact with the sealed source.

2. Ensure there are no individuals on the opposite side of the surface you are evaluating. This will minimize the potential for accidental exposure.

3. Avoid prolonged or unnecessary exposures; i.e., handle sources only in the performance of duty.

4. Transfer materials from place to place in a manner that minimizes the possibility of contamination from breakage.

5. In case of broken or damaged containers of radioactive materials, notify the RSO, radiological monitor, and supervisors immediately to survey the extent of the hazard, and place in a plastic bag to reduce contamination. If contamination is found, the RSO directs the decontamination, as necessary, ensuring that all unusable materials and components are packaged safely and disposed of properly.

Decontamination is very much like a thorough cleansing of dirty surfaces in that you use essentially the same methods. However, the radiological contamination may be more difficult to see and remove; so we check with instruments before and after cleaning. Also, keep in mind that all materials used to clean surfaces are considered contaminated and must be disposed of as radioactive waste.

Dosimetry

Due to the high exposure rate associated with this instrument, it is required that all individuals using or supervising the use of this instrument, be placed on the USAF Dosimetry Program and issued dosimetry badges. It is the supervisor's responsibility to ensure the dosimetry badge is worn and worn properly.

Sample Collection Procedures and Data Interpretation

Paint Chip Samples

Paint chip samples will be necessary to correct for substrate and to obtain laboratory confirmation of an inconclusive lead XRF reading. It is imperative the entire paint chip be removed for the analysis. There are currently three accepted methods for paint chip removal that will minimize the amount of substrate removed. These methods are explained in Appendix 5. Each chip sample should be at least 1 square inch (consult contract laboratory for specific requirements).

A tray or similar collection device will be necessary to catch any falling debris as all three techniques are fairly messy.

Results Interpretation

The action level is 0.5% by weight or 1.0 mg/cm^2 when laboratory analysis is used. If the laboratory results are to be reported in mg/cm^2 then the paint must be removed down to the bare substrate from a measured surface area; accurate determination of the surface area is important but adherent substrate or other nonpaint material will not affect the result. If the laboratory results are to be reported as weight percent then the paint must be removed down to, but not including, the bare substrate; inclusion of substrate materials in the paint sample or not removing all of the paint will affect the results.

Lead Dust

Interior house dust commonly contains lead which originates from outside dirt tracked into the house by people and pets and from normal deterioration of paint. The most common place to find lead in house dust is on windowsills and wells. This is because lead-based paint was used on these surfaces more often in the past, and the opening/closing action causes the paint to deteriorate. These areas are usually very difficult to clean and are usually easily accessible to young children. Another common place to find lead in dust is on the floor near windows or doorways. It will be necessary to collect dust wipe samples as an integral part of a LBP risk assessment. Reference Appendix 6 for lead dust wipe sampling procedures.

These dust lead levels can be reduced by meticulous housekeeping, especially regular cleaning of floors, windowsills and window wells. Wet mopping and wiping on a regular basis are particularly effective in controlling accessible dust. However, lead dust reaccumulation rates are likely to be rapid if the paint is in poor condition or if renovation is underway. Note that ordinary vacuuming of dust known or suspected to be leaded should not be used as a cleaning method.

Collection of 3 samples is recommended (floor, windowsill, and window well) per abated or high risk area. The exact location to be sampled should be randomly selected. For example, randomly select a location within a room for the floor sample. Likewise, if a room has several windows, randomly select a windowsill and a window well (independently) for sampling. A random number generator on a hand-held calculator, or a table of random numbers, are useful tools for accomplishing random selection.

Interpretation of Test Results

Typically, results are reported from the laboratory as total weight of lead present on the wipe. The inspector must then convert the reported results to units of micrograms per square foot ($\mu g/ft^2$) for direct comparison to the clearance standards.

EXAMPLE: The laboratory reports 0.08 milligrams (mg) of lead on a wipe taken from a windowsill of area 3" by 30". The total area sampled is:

$$(3 \text{ in.})(30 \text{ in.})(1 \text{ ft}^2/144 \text{ in.}^2) = 0.625 \text{ ft}^2$$

The total amount of lead present is:

$$(0.08 \text{ mg})(1000 \mu g/mg) = 80 \mu g$$

Thus, the concentration of lead in the dust is:

$$80 \mu g/0.625 \text{ ft}^2 = 128 \mu g/ft^2$$

Lead in Soil

The soil surrounding a dwelling can be contaminated with lead from several different sources. The first possibility is weathering and "chalking" of lead-based paint from the building exterior. Many older single-family homes have exterior lead-based paint, especially in colder climates such as the East and Midwest, because lead-based paint was the most durable for these conditions. The second possibility is airborne contamination from leaded gasoline. Although leaded gasoline has been generally phased out under an EPA ban, many millions of tons of lead entered the environment from this source up until the late 1980s. For dwellings close to highways or major surface streets, considerable lead contamination of the soil is possible.

The major exposure route for lead in soil is the same as that of lead in dust; unintentional ingestion by young children via hand-to-mouth activities.

As with dust wipe sampling, soil sampling is needed to completely evaluate maximum potential exposure to lead by young children. Refer to Appendix 7 for lead soil sampling procedures. A composite sample which consists of three to five soil cores mixed together should be taken from each side of the building to achieve a representative sample of the area.

Many different dwelling exterior configurations can be found AF-wide. Therefore, only general guidance will be given on the number and location of soil samples. First, prepare a site description. Make a detailed drawing showing: the boundary of the lot; the position of the main building and any other structures such as garages and storage sheds; the position of sidewalks, driveways, and other paved areas; the position of play areas (if clear); the position of areas with exposed soil, roof rain sprouts, and general drainage patterns; the drip lines of the buildings; and, areas of heavy traffic. In addition, describe the location of the property including the following information: (1) type of building construction; (2) condition of main building; (3) condition of the property and nature of adjacent property; (4) fencing and animals on the property; and, (5) use of the property.

The number of samples necessary depends on the area of the exposed soil around the dwelling. If the soil surrounding the dwelling extends less than 6 feet from the foundation, a single composite sample can be taken. This sample should consist of a composite of five soil cores taken randomly at locations within 2 feet of the building foundation. If more than 6 feet of soil surrounds the foundation, but the width (distance from the foundation) of the yard is 10 feet or less, two composite samples should be taken. One of these samples should consist of five randomly located cores within 2 feet of the foundation. The other should consist of five cores randomly located at the yard boundary. If the soil area around the dwelling is larger still, wider than 16 feet and longer than 20 feet, the area should be divided in two, and three composite samples of five cores each should be taken. One sample should consist of cores taken within 2 feet of the foundation. The second should consist of five random cores in the first half of the yard; and, the third composite should be taken from five cores in the second half of the yard.

Laboratory analyses of soil core samples for lead are carried out using either a laboratory XRF instrument, or by acid digestion followed by Atomic Absorption Spectroscopy. The results are reported in parts lead per million parts of soil by weight (ppm). Because 5 soil cores are used to make up a single composite sample, the composite sample lead concentration represents an average soil lead concentration over the area where the cores are taken. For example, the composite taken close to the foundation, and consisting of 5 cores at random locations in this area, represents an estimate of the average soil lead concentration close to the foundation of the dwelling. This captures the impact of weathering of exterior paint on soil lead concentrations near the building.

As in the case of leaded dust, there is no Federal health-based standard for levels of lead in soil, although the State of Minnesota recently established a risk-based requirement for abatement of soil with levels above 300 ppm lead. Until a Federal standard is developed, a de facto level of 500 ppm is often accepted as a level of concern for lead in soil. This does not mean that levels exceeded 500 ppm constitute, in and of themselves, an imminent health hazard. Neither should it be inferred that a 500 ppm level is safe, especially in a child's play area. Residents and property owners may wish to take some simple steps to minimize the potential for exposure of children to lead in soil if levels seen in soil exceed 500 ppm.

References

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Environmental Protection Agency. Standard Operating Procedures for Measurement of Lead in Paint Using the Scitec Map-3, X-ray Fluorescence Spectrometer. September 1991

Title 49 of Code of Federal Regulations, Part 173, Section 422. Shipper's - General Requirements for Shipments and Packaging. October 1992

T.O. 00-110N-3. Requistion, Handling, Storage, and Identification of Radioactive Materials. 15 August 1986

SECTION IV

LEAD-BASED PAINT HAZARD DETERMINATION

The assessment of environmental lead hazards and lead hazard abatement planning and monitoring may include visual inspections, sampling for lead in paint, dust, soil, water, and air depending upon the purpose of the assessment and the nature of the environment. Widely accepted standards for lead sampling and measurement methods are not available within the Federal Government at the present time. There is ongoing research in every area of testing and measurement. The procedures and practices in these guidelines provide interim guidance until federal regulations are established. The approach discussed in these guidelines:

1. Give priority to find and reduce or eliminate the risk of existing hazardous conditions in high-priority facilities.

2. Emphasize in-place management to control existing hazards and reduce the risk of hazardous exposure to acceptable levels.

3. Consider abatement of LBP as part of normal facility renovation and upgrade programs when it is cost-effective.

4. Ensure precautions and procedures are incorporated into all maintenance, repair, renovation, and upgrade activities which are performed in-house, by contract, or self-help and which disturb painted surfaces known or likely to contain lead.

High priority facilities are facilities or portions of facilities which are (or may be) frequented or used by children under age 7. They are further prioritized as follows:

1. Child development centers, annexes, and playground equipment

2. On-base Air Force licensed family day care homes

3. Youth centers, recreational facilities, and playgrounds

4. Waiting areas in medical and dental treatment centers

5. Air Force-maintained Department of Defense Schools

6. Military family housing (MFH) currently occupied by families with children under 7 years

7. Remaining MFH

Visual Inspections

Visual inspections are evaluations specifically designed to locate existing and potential LBP hazards. They focus on high-priority facilities and areas within those facilities with painted surfaces in deteriorated condition. These evaluations will be performed by a team consisting of Base Civil Engineering and Base Bioenvironmental Engineering representatives or by a qualified contractor in conjunction with a certified laboratory. The following are the procedures for inspecting and evaluating surfaces of high-priority facilities and actions to take based on the resulting assessment.

The first step should be to evaluate the condition of the painted surfaces for chipping, peeling, cracking, dust, and evidence that children have been chewing or mouthing painted surfaces. Figure IV-1 contains a suggested form for these inspections and Figure IV-2 summarizes the visual inspection protocol. If the surfaces are in good condition and there are no signs of paint deterioration or chewing:

1. Instruct the occupants on proper care and maintenance of painted surfaces. Some of the precautions that the occupants can take to minimize exposure to lead are explained in Section II, Medical Childhood Blood Lead Surveillance Program.

2. Schedule the facility for LBP testing and analysis in accordance with the established management plan.

If there are signs of paint deterioration, including evidence of chewing, and the facilities are currently occupied by families with children under 7 years of age, a pregnant woman, or are otherwise considered high priority, action must be taken as soon as possible to make a confirmed determination of whether or not the deteriorated surface contains lead.

1. Quantitatively test the paint for lead using an X-ray fluorescence spectrum analyzer or collect a paint chip sample. If using the MAP-3 (Scitec Co.), take a single measurement in the test or confirmation mode. Procedures for paint testing using the MAP-3 are explained in Section III of this report, Lead Sampling and Analysis.

2. The following readings are considered positive:

Testing Mode	Reading
Test[4,5]	$\geq$ 0.3 mg/cm^2
Confirm[4,5]	$\geq$ 0.5 mg/cm^2
AAS, ICP	$\geq$ 0.5% by weight, or 1 mg/cm^2

If testing cannot be completed in an expedient timeframe and:

a. The deteriorated surface is in the interior of the facility, remove children from the hazard area as soon as possible and instruct the occupants to report to the medical treatment facility to have blood lead level determinations performed on children under age 7.

b. The deteriorated surface is on the exterior of the facility, recommend blood testing as soon as possible only if the surface is accessible to children under age 7, or if children frequently play in the area adjacent to that surface.

Based on the degree of hazard determined by the BEE in consultation with the BCE representative, complete actions determined to be appropriate for the circumstances, e.g.,: isolate the area; relocate

[4] MAP-3 Spectrum Analyzer (Scitec Co.) only.

[5] Based on the reported precision of the MAP-3, at the 99% confidence interval

the occupant; in-place management; abatement; and/or cleanup. Perform clearance sampling before allowing the occupants to access or reoccupy the area or facility. Follow the clearance sampling procedures and criteria discussed in Section VII, Abatement and Cleanup. If there are signs of paint deterioration in MFH units which are not currently occupied by families with children under seven years of age and are not used as a family day care home, the facility should be scheduled for in-place management and cleanup at the earliest possible date. Instruct the occupants not to disturb painted surfaces (self help, etc.). The housing office should ensure that no pregant woman or no children under age 7 occupy the facility until it is either confirmed LBP-free or appropriate in-place management or abatement, cleanup, and occupant education on care of painted surfaces have been completed.

c. If lead above the action level is not found, document the finding. No further action is required.

Risk Assessment of Lead-Based Paint Hazards

Risk assessments are used to determine whether LBP hazards are present and to assess whether existing management and maintenance programs are adequate to handle LBP hazards in high priority facilities during routine maintenance prior to complete abatement. LBP risk assessments are also used when performing lead toxicity investigations (LTI). Also, results from the risk assessment are used as a starting point for more comprehensive surveys. The major characteristics of a LBP risk assessment are:

1. Consider multiple sources of lead: paint, dust, soil, water, and air

2. Emphasize assessment of lead-containing dust, both indoor and outdoor

3. Emphasize the detection of immediate potential risks as well as long-term potential risks

4. Emphasize interim measures to prevent potential poisoning until surveys can be completed and full-scale abatement can be budgeted

5. Emphasize high risk populations

Risk assessment of LBP hazards includes the review of existing maintenance and management techniques, collection of paint, dust, soil, and water samples to determine where and how much lead is present in the housing environment. If performed due to a LTI, it must also include a parent's interview to pinpoint other sources of lead in the housing environment (i.e., hobbies, work, etc.). Positive results from LBP risk assessment will lead to an in-place management program in those facilities where abatement activities are not possible in the near future.

The Lead Exposure Risk Assessment (LERA) generally consists of the following tasks:

1. Review available facility information (dates of construction, painting and modification history, drawings and specifications, and blood lead data) and develop a public awareness program for housing occupants in cooperation with the housing office.

2. Prepare a written plan to select a test sample of facilities

3. Perform a Lead-Based Paint Risk Assessment

Address

High Priority Facility? Y or N

Inspector Name/Off Sym/Phone #

Date

XRF Used? Y or N Model #/Serial #

BEE Review
BEE Name/Grade/Duty Title/Signature

CE Review
CE Name/Grade/Duty Title/Signature

Interior Room Number	Condition Good/Deteriorated	Quantitative Testing 1	2	3	

Exterior Side	Condition Good/Deteriorated				

Figure IV-1. Visual Inspections Form

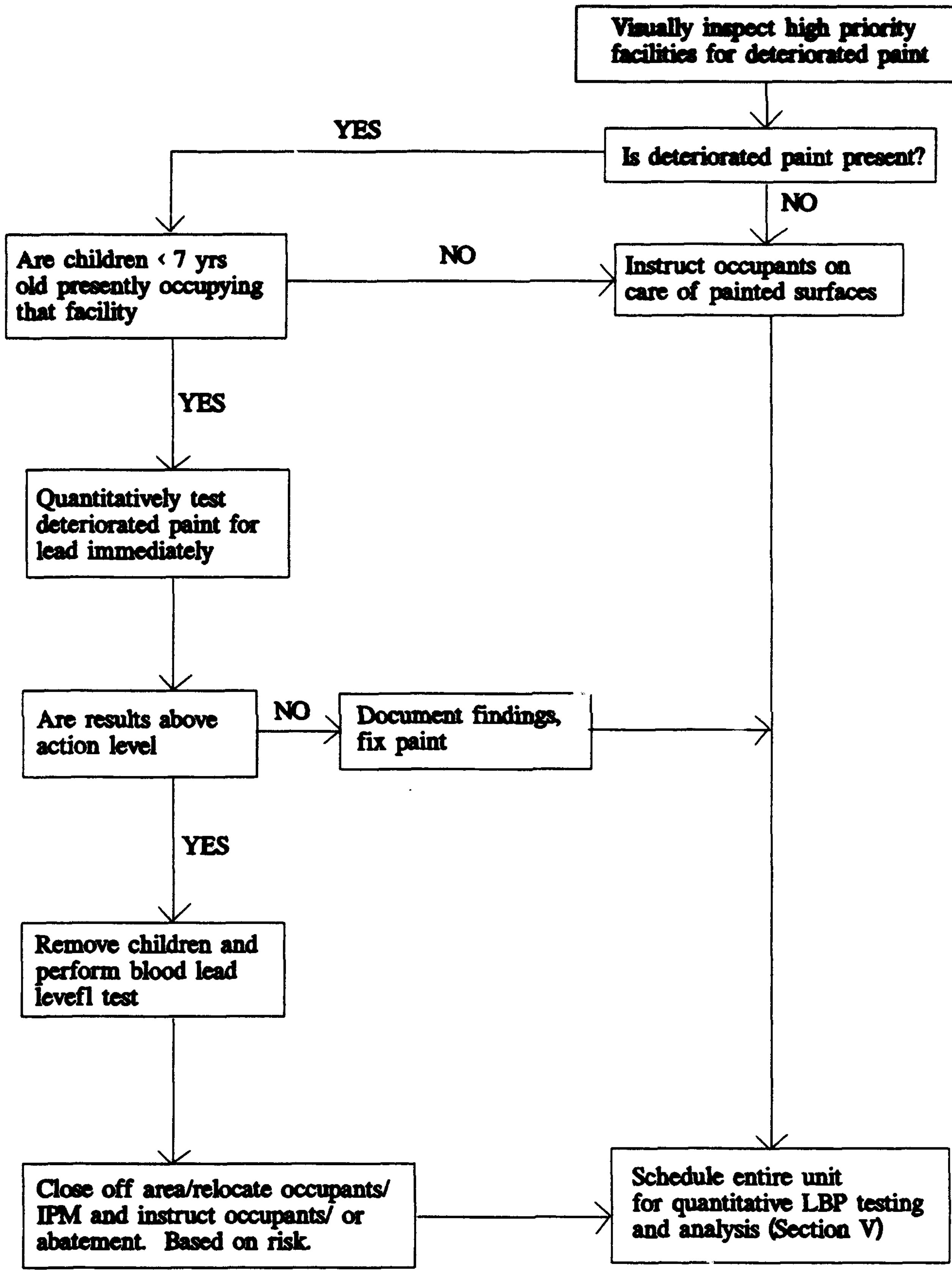

Figure IV-2. Visual Inspections Protocol

Records Review

Records review is probably the most important step in the risk assessment process. Careful planning and knowledge of the history of your facilities will help you divide your facilities in homogenous groups and will help in the interpretation of the results later on. Development of background information provides the BEE with data for the purpose of identifying those units, common areas, community facilities, and site areas that should be tested and inspected first. Some of the information that may be included is:

- Site plan and building plan. (Plans are needed to develop an appropriate sampling strategy for each development.)

- A list of addresses by type of unit or type of facility which are regularly used by children under age 7. (Addresses are also needed to develop an appropriate sampling strategy.)

- A copy of test results if lead testing has been performed at this development. (These documents are needed to determine if enough units were tested, whether or not all painted surfaces were tested, and the quality of testing.)

- Reports of elevated blood lead (EBL) levels.

- Health, safety, or building code violations encountered in the development. (This information will assist in determining the likely condition of substrates, and the quality of building maintenance. For example, the facility may be scheduled for demolition and as a consequence maintenance has been limited or a high concentration of lead in drinking water was found.)

- Drawing and specifications of the facilities.

- Probable LBP surfaces.

- Available information on any substantial maintenance projects conducted at this facility. (Previous substantial maintenance work is reviewed to determine whether any substantial disturbances of lead took place. It may also be helpful in identifying lead-free surfaces.)

- Number children. (The more children, the greater the potential risk if lead is present.)

- Points of contacts for all information collected.

LBP Risk Assessment

These sampling and inspection guidelines are to assist the BEE in selecting facilities and site areas for lead-based paint inspection and testing. The objective of the risk assessment is to find locations that are most likely to have the highest loadings of lead dust in a given facility (worst-case), not to take a representative sample of all units or common areas. Lead dust is one of the most immediately accessible sources of lead exposure to children, as well as adults. The LBP risk assessment can be performed in conjunction with the visual inspections.

Worst-case sampling is typically used in combination with random sampling to reduce survey costs, by focusing on potential high-risk facilities. The survey information may then be used to justify in-place management activities for an entire group of housing units. The drawback to this approach is that the number of housing units tested, and the testing methods used, do not provide detailed comprehensive information at a high confidence level to support decisions for broad-scale abatement efforts.

Experience indicates that it is important to take dust samples in the following places:

- Inside apartment units in which a child with an elevated blood lead level resides.
- Inside units which the BEE, MPHO, or BCE found in poor condition.

Within units and common spaces, dust samples should be taken on floors and window wells (where the sash rests against the sill) or windowsills if the wells are not accessible. HUD has found that window wells have higher dust lead loadings than any other interior dust sampling location; probably because window wells are rarely cleaned and because they can catch exterior as well as interior sources of lead.

Table IV-1 indicates the minimum number of similar units or spaces to inspect and sample.

Table IV-1. Number of Units to Inspect During the LERA

Number of units	Number of units to inspect and sample
1 - 4	all
5 - 74	5
75 - 124	6
125 - 174	7
175 - 224	10
225 - 299	12
300 - 399	15
400 - 499	18
500+	20*

*per 500 units plus 2 for each additional increment of 50 units

For scattered site units (CDC, schools, MFH in which the BEE cannot establish similar construction and paint histories) each unit should be inspected and samples collected.

Fifty to sixty percent of the units required in the sampling table should be worst-case units. Worst-case units are units that are more likely to have lead hazards accessible to children (i.e., units with poor housekeeping or in which recently conducted renovation or other work that disturbed paint and created dust). Randomly select the other 40%-50% of the units requiring sampling. Prior to conducting any sampling, instruct the occupants NOT to perform any special cleaning.

Rooms to be sampled: Within each unit, sample the living room, kitchen, and two children's bedrooms. If two children's rooms are not possible, sample one child and one adult bedroom.

Number and location of samples: In each selected room, dust samples should be obtained from one window well (or, if not possible, a windowsill) and one floor area. Measure and record the area of the window sampled. Sample one square foot of floor.

Select those windows that are in poor condition or that are opened and closed most frequently. For floors, sample areas likely to have high concentrations of lead dust (e.g., under peeling paint, under windows, near entryway, corners, etc.). If floors cannot be sampled (carpeting, etc.), collect an additional window sample.

If the risk assessment is performed in conjunction with the visual inspections, inspect all surfaces in all rooms for defective paint conditions. Table IV-2 summarizes the sample requirements for MFH and scattered site units.

Common areas: Common areas and stairwells connected to the unit(s) to be inspected should be selected for inspection and sampled as follows:

- One lead dust sample at each stair/hall and entry/landing floor area and one from the window well

- One paint sample at each representative surface in poor condition

- One soil sample at 0-3 ft and 10-20 ft from building near common hallway/stairway

In child development centers and other high priority (up to 2000 sq. ft.) areas, collect two dust samples from the floor and two from window wells/sills. Select worst-case conditions. Collect an additional dust sample for each 2000 sq. ft. increase in building size.

Soil sample collection: For MFH and other buildings collect one composite sample (procedures are in Section III, Lead Sampling and Analysis) at 0-3 feet away from building and one composite sample at 10-20 feet away from building. Collect samples in bare areas near suspect surfaces (older paint). If paint chips are present and could be accessible to children, include them in the composite sample. In play areas, collect a composite sample in each area. Collect at areas most likely to be used by children; e.g., at bottom of slide, under swings, in sand play area, etc. Tables IV-2 and IV-3 contain the number of samples required.

Paint chip samples: Collect a paint chip sample in any area where paint is in poor condition and readily accessible to children. If chip samples were collected during the visual inspection stage document the results. If paint is in good condition, perform XRF testing on each room selected for sampling. This technique will not give you a high degree of confidence but will provide information

on components more likely to contain LBP. During an EBL risk assessment, more comprehensive paint testing should be performed using an XRF. Follow the protocol for scattered site housing in Section V, Comprehensive Surveys.

Table IV-2. Family Housing Units and Scattered Site Units Sampling Requirements

LOCATION	INSPECTION	SAMPLE NUMBERS				
		DUST		PAINT	SOIL	WATER
		Floor	Window Well/Sill			
Living room	all painted surfaces	1	1	1 for each representative surface in poor condition/accessible		
Kitchen	all painted surfaces	1	1	same as above		2
Bedroom No. 1	all painted surfaces	1	1	same as above		
Bedroom No. 2	all painted surfaces	1	1	same as above		
Other	all painted surfaces			same as above		
Outside 0-3 ft from building	bare soil areas near suspect surfaces			include visible paint chips if accessible	1	
Outside 10-20 ft from building	same as above			include visible paint chips if accessible	1	
TOTAL		4	4	?	2+	2
Play areas	painted surfaces on play equipment				1	
Parking lots	bare soil areas of perimeter near suspect surfaces				1	
Main roadways	at soil edge which intersects with high traffic roadway				1	

Note: Water samples are only recommended when performing a LTI

Table IV-3. Family Life Support Buildings Inspection/Sampling Requirements

LOCATION	INSPECTION	SAMPLE NUMBERS				
		DUST		PAINT	SOIL 0-3 ft and 10-20 ft from bldg.	WATER
		Floor	Window Well/Sill			
Building ≤ 2000 ft^2	all painted surfaces in interior and exterior areas accessible to children	2-widely separated samples in "high traffic" areas used/ accessible to children	2-worst case	1-3 for each representative surface in poor condition	2- at bldg. exterior near common entry/ stairs	2
Building > 2000 ft^2	all painted surfaces in interior and exterior areas accessible to children	2 + 1 (per additional 1000 ft^2) widely separated in high traffic areas used/ accessible to children	2 + 1 (per additional 1000 ft^2) "worst case"	1-3 for each representative surface in poor condition	same as above	2
Management Office or other (e.g., clinic) waiting areas ≤ 400 ft^2	all painted surfaces accessible to children	1				
Management Office or other (e.g., clinic) waiting areas > 400 ft^2	all painted surfaces accessible to children	2				

Note: Water samples are only recommended when performing a LTI

References

Department of the Air Force. Air Training Command. Lead-Based Paint Management Plan. Draft. March 1993

Department of the Army. Engineer Technical Letter 1110-X1, Lead-Based Paint Sampling and Measurement - Methods and Standards. U.S. Army Corps of Engineers, Huntsville Division. Draft, January 1993

Department of Housing and Urban Development. Lead-Based Paint Risk Assessment Protocol. Federal Register, Vol. 57, No. 125. June 29, 1992

SECTION V

COMPREHENSIVE SURVEYS

Upon completion of Visual Inspections and Risk Assessments, the LBP program officer might decide that a more comprehensive survey is necessary to better characterize the location of LBP at the base. This chapter will describe in detail the recommended procedures for comprehensive surveys. The HUD Interim Guidelines protocol for comprehensive testing of family housing units or other buildings are very time consuming and expensive. This section provides an alternative protocol for comprehensive surveys, dividing comprehensive testing into two phases. Phase I consists of sampling a small number of units based on the assumption that at least 20% of the units are leaded. Phase II consists of analyzing the results of Phase I and determining if more sampling is necessary. This protocol will help you determine the confidence level of the data obtained (i.e., when the results from some units can be used to draw conclusions about similar units) and provides the basis for a contract scope of work.

Unit Presurvey

For purposes of lead-based paint inspection, housing may be divided into three types: single-family, multifamily, and multibuilding multifamily. Multibuilding multifamily housing consists typically of groups of high-rise apartment buildings forming a single complex for administrative purposes. Multifamily units are a group of apartments, buildings, or single units with similar characteristics such as floor plan, construction materials, painting histories, and date of construction. Military family housing units will normally fall into this category. Thus, it is conceptually appropriate to test such units based on a random sample of dwelling units (taking care that different units with different construction and history are not lumped together). Random sampling reduces the cost of testing and makes it possible to reach rational decisions for large complexes without exhaustive testing. Random sampling is also appropriate, though less efficient, for smaller multi-family developments. As the size of the development decreases, a relatively higher percentage of dwellings must be tested in a random sample. The most difficult testing situation is scatterred-site housing, because each dwelling has its own unique construction and painting history, so that each must be tested separately. Test results for one dwelling cannot be extrapolated to other dwellings in a defensible way.

A "LBP Testing Plan" is defined as a listing of the specific dwelling units, common areas, and exterior areas to be tested (completely and unambiguously defined, say, by address and unit) and a delineation of the specific architectural components to be tested in each room in each unit, each common area and each building exterior. In order to develop the plan, the planner must have:

- A complete listing of all common areas in the development;

- For each unit type, either a set of architectural drawings of the unit, or a list of painted surfaces. These documents must lay out all of the rooms, interior and exterior, in the specific type of unit and show what architectural components are contained in each of the rooms. (Components are things like walls, windowsills, doors, etc. They will be discussed in detail.) Information on the painting history of the development is also desirable;

- Listings or drawings of common-area components; and,

- Information on building types and typical exterior components.

The first task of the planner is to carry out a visual inspection to verify the accuracy of the available information described above. Then, he/she must select the specific set of units to be tested. The HUD Interim Guidelines suggest that, instead of testing every unit in a development, a sample of the units be tested. This concept rests on the notion that developments are uniformly painted at the time of construction. This assumption supports the idea that inspectors can ascertain the presence of LBP by testing a sample of units. The benefits of this situation are clear: the inspectors can efficiently use the resources set aside for testing, and efforts can be concentrated on doing a very accurate and effective job on those units which are tested.

Paint Histories and Unit Similarities

A second key concept is how units should be grouped together for the purpose of selection. In some cases, all of the dwelling units in a particular multifamily development will have been constructed at about the same time and will have experienced a similar painting history (for example, following a rule that says a unit is repainted whenever the resident moves or every 5 years, whichever is sooner). Alternatively, the development may be comprised of numerous buildings which have very different histories. Even if the repainting regimen is constant throughout the development, differences in date of construction could result in different amounts of LBP on the wall and other components in the development. Therefore, it is essential that groups of units with similar construction dates and painting histories be put together for the purposes of selecting units to be tested. The HUD Interim Guidelines call this grouping of units a "Group of Similar Buildings."

Sample Locations

Once a Group of Similar Buildings is determined, the planner should make a list of all exterior and interior components to be tested. This list should be divided into "components likely to contain LBP" and "components not likely to contain LBP." Develop this list by using results from visual inspections, risk assessments, previous sampling, painting histories, or prior knowledge. This list will be used to determine whether additional sampling is necessary. For example, based on our experience in MFH, we expect that units built between 1960 and 1970 will contain LBP on the baseboards, doors, windowsills, and almost all exterior components. However, interior walls and ceilings do not normally contain LBP. The planner must then decide how many units will be tested in that group. The HUD Interim Guidelines recommends a sample size based on a 95% confidence that if at least 5% of the units (or 50, whichever is smaller) are leaded, at least one leaded unit will be selected for inspection (Table V-1). In the table, group sizes are unshaded, while the number of units to be tested is shaded.

The assumption that fewer than 5% of the units contain leaded paint is conservative. According to Table 3.3 of the HUD report (reproduced in Table V-2), the incidence of lead-based paint in occupied housing is different under four different lead concentration thresholds. As you can see from Table V-2, all percentages with paint lead concentrations $\geq$ 1.0 mg/cm^2 are well above the 5% used in the calculation of Table V-1. By assuming that a higher percentage of units are leaded, say 20%, the sample size decreases dramatically. Table V-3 contains the required sample size under the assumption that 20% of the units are leaded and the probability of selecting at least one unit is no less than 0.95. Phase I sampling should be performed following the sample size in Table V-3.

The next step in the plan is to determine the specific units to select. Suppose that a Group of Similar Buildings has 30 units, so that 11 of these units will be sampled. The planner must select the units at random. Random sampling will ensure that no preconceived notion regarding where to sample can taint the selection of the units. The selection procedure should start with the complete listing of all units in the building. This list can be in any order when using this procedure. Next, the units should be numbered from 1 to the total number. In the example, the last unit number in the list will be 11. Random numbers are used to select which units out of the 30 to include.

Unit Selection

Table V-4 is an example of how random numbers can be used to select the units to be sampled. Start with the column titled, "Random Number." Use the hand held calculator repeatedly to fill in random numbers (as many as needed). The third column is obtained by multiplying the total project size (30 in this case) by the random number. The fourth column is obtained by rounding up from that calculation. For example, take the first number in the last column (17), indicate that it is a valid member of the sample by showing the next available sample number in the first column (which in this case is 1). If the value in the last column is a repeat, then we do not number that selection. Rather, we indicate that it is not to be included by entering "DUP" (meaning duplicate). The process continues until 11 unique case numbers are selected.

Documentation and Suggested Forms

For each dwelling unit in the sample, it is the inspector's job to test a surface that is representative of each type of painted component in every room, closet, pantry, hall, and part of a divided room (e.g., living room/dining room). Table V-5 lists commonly encountered components, interiors and exteriors, which should be tested. The table is not intended to be exhaustive; i.e., unlisted components that are encountered must still be tested. Note that the table applies to surfaces with the same painting history. For example, if there are two baseboards in a room that have different color paint, then both must be tested. In addition to the specific units, whose selection was described previously, the inspector has the responsibility to test each common area in each building and the exterior of each building. Several pages of sketches of specific building components are provided in Appendix 8.

One of the major responsibilities of the inspector is to keep detailed records. Listed below are the three recommended forms to be completed during the survey and how they should be used. They are:

- Lead-Based Paint Sampling Plan (one for each type unit);

- Exterior Sampling Plan (one for each unit); and

- Interior Sampling Plan (as many as needed, one for each room).

Table V-1. Number of Units to be Tested (Shaded) According to Project Size (Unshaded)

20	20	120	47	1280	74	1745	101	2209	128	2673	155	3137	182	3602	209	4066	236	4530	263
27	21	139	48	1298	75	1762	102	2226	129	2690	156	3155	183	3619	210	4083	237	4547	264
28	22	158	49	1315	76	1779	103	2243	130	2708	157	3172	184	3636	211	4100	238	4565	265
29	23	178	50	1332	77	1796	104	2260	131	2725	158	3189	185	3653	212	4118	239	4582	266
31	24	198	51	1349	78	1813	105	2278	132	2742	159	3206	186	3670	213	4135	240	4599	267
32	25	219	52	1366	79	1831	106	2295	133	2759	160	3223	187	3688	214	4152	241	4616	268
33	26	259	53	1384	80	1848	107	2312	134	2776	161	3241	188	3705	215	4169	242	4633	269
35	27	300	54	1401	81	1865	108	2329	135	2794	162	3258	189	3722	216	4186	243	4651	270
36	28	380	55	1418	82	1882	109	2346	136	2811	163	3275	190	3739	217	4204	244	4668	271
37	29	500	56	1435	83	1899	110	2364	137	2828	164	3292	191	3756	218	4221	245	4685	272
38	30	700	57	1452	84	1917	111	2381	138	2845	165	3309	192	3774	219	4238	246	4702	273
40	31	1005	58	1470	85	1934	112	2398	139	2862	166	3327	193	3791	220	4255	247	4719	274
51	32	1023	59	1487	86	1951	113	2415	140	2880	167	3344	194	3808	221	4272	248	4737	275
52	33	1040	60	1504	87	1968	114	2432	141	2897	168	3361	195	3825	222	4290	249	4754	276
54	34	1057	61	1521	88	1985	115	2450	142	2914	169	3378	196	3842	223	4307	250	4771	277
55	35	1074	62	1538	89	2003	116	2467	143	2931	170	3395	197	3860	224	4324	251	4788	278
57	36	1091	63	1556	90	2020	117	2484	144	2948	171	3413	198	3877	225	4341	252	4805	279
59	37	1109	64	1573	91	2037	118	2501	145	2965	172	3430	199	3894	226	4358	253	4823	280
60	38	1126	65	1590	92	2054	119	2518	146	2983	173	3447	200	3911	227	4375	254	4840	281
74	39	1143	66	1607	93	2071	120	2536	147	3000	174	3464	201	3928	228	4393	255	4857	282
76	40	1160	67	1624	94	2089	121	2553	148	3017	175	3481	202	3946	229	4410	256	4874	283
78	41	1177	68	1642	95	2106	122	2570	149	3034	176	3499	203	3963	230	4427	257	4891	284
80	42	1194	69	1659	96	2123	123	2587	150	3051	177	3516	204	3980	231	4444	258	4909	285
96	43	1212	70	1676	97	2140	124	2604	151	3069	178	3533	205	3997	232	4461	259	4926	286
98	44	1229	71	1693	98	2157	125	2622	152	3086	179	3550	206	4014	233	4479	260	4943	287
100	45	1246	72	1710	99	2175	126	2639	153	3103	180	3567	207	4032	234	4496	261	4960	288
118	46	1263	73	1727	100	2192	127	2656	154	3120	181	3585	208	4049	235	4513	262	4977	289
																		4995	290
																		> 5000	299

Note: For project sizes not shown, use closest smaller project size (e.g. for a project with 73 units, test 38 units).

Table V-2. Percentage of Occupied Homes with Lead-Based Paint by Lead Concentration, Year of Construction, and Location of Lead-Based Paint

Location and Construction Year	Percentage of Homes			
	Paint Lead Concentration (mg/cm^2)			
	≥ 0.7	≥ 1.0	≥ 1.2	≥ 2.0
Interior				
Built before 1940	73%	60%	57%	50%
1940 - 1959	70%	59%	44%	20%
1960 - 1979	60%	41%	28%	7%
Exterior				
Built before 1940	83%	79%	69%	66%
1940 - 1959	82%	76%	69%	46%
1960 - 1979	55%	42%	31%	12%
Anywhere in Building				
Built before 1940	94%	90%	79%	75%
1940 - 1959	87%	80%	74%	52%
1960 - 1979	80%	62%	47%	18%

Table V-3. Number of Units to be Tested According to Project Size When at Least 20% of the Units are Leaded

Number of Similar Units	Sample Size
1 - 8	all
9	8
10 - 13	9
14 - 19	10
20 - 31	11
32 - 58	12
59 - 212	13
213+	14

Table V-4. Example of Random Numbering Technique and Documentation

Sample Number	Random Number	Product with Total	Rounded up Value (Selected Case)
1	0.575	17.25	17
2	0.241	7.230	7
DUP	0.560	16.80	17
3	0.884	26.52	27
4	0.341	10.23	10
5	0.851	25.53	26
DUP	0.574	17.22	17
DUP	0.221	6.63	7
6	0.103	3.09	3
7	0.375	11.25	11
8	0.625	18.75	19
9	0.395	11.85	12
DUP	0.095	2.85	3
10	0.772	23.16	23
11	0.515	15.45	15

The Lead-Based Paint Sampling Plan, Figure V-1, is designed to contain information about the entire group of unit type. The responsibility for preparing this page lies with the manager of the testing project, but it is important for inspectors to know its contents. This page contains identifying information about the unit, the number of rooms, relevant dates, the specific individuals who performed the testing, information about the XRF analyzer used, and a sketch of the entire unit. Each room in the unit is identified by a unit number which references other documentation. The inspector must be totally familiar with the layout of the unit, and the sketch will help in planning the order of testing the rooms and the general approach.

The second sheet is the Exterior Sampling Plan, Figure V-2. There will be one such sheet for each unit identified in a manner consistent with the sketch on the cover page. This sheet also contains the details of the components of the unit exterior surfaces, survey locations and readings. Each location where XRF sampling is done is to be indicated on the drawing and numbered.

The last recommended form is the Interior Sampling Plan (Figure V-3). This form contains the details of the components in the room, including closets, windows, doors, etc., by number. There is a space provided to map out the details of the room. Each location where XRF sampling is done is to be indicated on the drawing and numbered. The room numbers used on this form must be consistent with those on the Lead-Based Paint Sampling Plan.

Unit Numbering Techniques

It is important that a standardized method of room and surface identification be adopted. Troubles can be encountered if the base uses one method for identification and the abatement contractor uses another. The following method is the most widely accepted within the LBP profession.

Figure V-4 gives an example of identifying walls by letter by its orientation to the street. The figure indicates the address of the unit is "123 Anystreet," thus the wall adjacent "Anystreet" will be identified as A with the remainder of the walls consecutively lettered clockwise. These letter references will be used to identify walls of interior rooms.

Figure V-5 gives an example of the room numbering technique. Beginning with the room in the A/D corner of the unit as number 1, begin to consecutively number the rooms in a clockwise fashion. There is no need to number the rooms that can only serve as their function (i.e., kitchen, halls, bathrooms, closets, etc.). These rooms should be identified as what they are when recording results; however, the potential exists to have more than one hallway or bathroom. When this exists, use the numbering technique above to identify them as bathroom 1, bathroom 2, etc.

Figure V-6 shows the suggested method of identifying surfaces within a room. Use the unit letter identification for wall orientation. Doors will be closed and identified as part of the wall they share (i.e., the door leading to the kitchen would be identified as Rm 1, B, door). Closet doors will typically be a point of confusion. The closet door facing the room would be identified as Rm 1, D, door; however, the confusion is created in identifying the interior surface of the door. The error usually will occur when the inspector designates the closet doors interior as Rm 1, B, door. As you can see, should abatement be necessary, the wrong door could be abated. For this reason, it is suggested that all closet door interiors be identified as Rm 1, D, closet door interior, for example. The remainder of the closet walls can be indicated as Rm 1, closet, A (B, C or D).

Windows also become a point of confusion during surveys, especially rooms with multiple windows. The suggested technique for the windows in Figure V-6 would be Rm 1, A, window AL (AC, AR, etc.) where L, C and R mean left, center, and right when facing the interior or exterior wall. It is important to note that these same windows will be labeled opposite when performing the exterior survey, as they are identified as left, center, and right when facing them. The identification for the exterior windows in this example would be Exterior, A, Window AL (AC, AR etc.). This method is more effective than attempting to number the windows, as not all inspectors will number left to right. If an enclosed patio is encountered, this will add a level of confusion to the above example. In this event, the patio would be identified as a room and numbered, thus the porch would become Rm 1 due to its relation to the A/D corner of the unit.

Selection of Representative Samples

Walls and ceilings are the easiest type of component to test, because the surface is flat. **Under the assumption that components are painted uniformly, the inspector should select a place at random on the surface, being careful to avoid pipes, electrical components, or other construction materials which could interfere with the readings.** If a surface is divided, for example, a wall is split into two sections by another wall or divider or a wall is divided by a chair rail, each section must be sampled. In the case of a chair rail, the rail itself is also considered as a separate component to be tested.

Most of the other surfaces listed in Table V-5 are not entirely flat. Since XRF analyzers are calibrated to provide accurate readings on flat surfaces, great care must be taken when surfaces are not flat. The best procedure is to strive to locate a section of the component to be tested which is as large and as flat as possible. For example, in some older homes the base and crown moldings, even the door casings, are large enough so that a good place to test can be found.

There will certainly be cases in which no flat sections will be available (for example, a radiator or decorative molding). Until a flexible lead-based paint standard is available to quantify the effect of surface curvature on the XRF reading, such surfaces must be tested by scraping the paint and submitting the sample for AAS testing in the laboratory.

The measurement of lead in paint by any XRF analyzer is affected by scattered X-rays from the material which the paint covers (the substrate). Interference from the substrate can bias the measurement high (overestimate the true lead level) or low (underestimate the true lead level). Because the Scitec instrument measures the complete spectrum of radiation received by the detector, a correction for substrate materials is often needed. Proprietary software developed by Scitec carries out substrate correction for a variety of common substrates including aluminum, wood, plaster, sheetrock, brick, plywood, steel, and concrete. The manufacturer claims that, because of this correction, the inspector does not need to correct the spectrum analyzer readings by scraping the paint from the surface and taking a bare substrate reading, as is required for direct reading XRF's. This claim was confirmed in a limited study conducted in the laboratory by the National Institute of Standards and Technology (NIST). However, more recent field data strongly suggests that the spectrum analyzer's built-in substrate correction is by no means perfect. Extensive validation data collected as part of HUD's national survey of lead-based paint in housing demonstrates that the spectrum analyzer tends to underestimate lead levels in paint on wood, drywall, and concrete (by as much as 70%), and to overestimate lead levels in paint on steel (by 60%). Moreover, the degree of bias observed depends on the particular instrument used.

NIST has developed a set of 5 Standard Reference Paint Films for use in lead-based paint testing. The colors, lead levels, and associated confidence intervals are as follows:

1. Yellow = 3.53 mg/cm^2 +/- 0.24 mg/cm^2
2. Orange = 1.63 mg/cm^2 +/- 0.08 mg/cm^2
3. Red = 1.02 mg/cm^2 +/- 0.04 mg/cm^2
4. Green = 0.29 mg/cm^2 +/- 0.01 mg/cm^2
5. White = <0.0001 mg/cm^2

The suggested cost of the complete set is $244.00 and may be ordered by calling NIST at (301) 975-6776, and referencing SRM # 2579. In order to standardize the substrate correction and field quality control for XRF testing, the NIST standard reference films should be used by all inspectors. Be careful not to use these standards beyond their expiration date.

Establishing Substrate Effects

In multifamily developments, it is important to test a substantial number of substrates in order to accurately determine substrate corrections to be used throughout the development. All measurements taken in multifamily projects must be substrate corrected. The following procedure should be used.

- Set aside 3 units in the development for use in substrate correction determination. In each unit, select 3 representative samples of each painted and varnished substrate to be tested. The samples to be tested should be selected at random from an available flat painted surface of each substrate in each unit. For each sample, scrape all paint (down to bare substrate) over an area at least equal the size of the face plate of the XRF.

- Place the red NIST standard reference film (1.02 +/- 0.04 mg/cm^2) over the scraped substrate and take a XRF reading in the TEST mode.

- For each substrate, compute the average ("m") of the 9 measurements with the red reference film. The substrate equivalent lead (SEL) (the "estimated bias" for the spectrum analyzer) is (m - 1.02) mg/cm^2. However, for the spectrum analyzer, if 4 or more of the 9 measurements are zero, discard the data and return to the above step using the orange film. If 4 or more of the readings on the orange film are also zero, send the spectrum analyzer in for service. Otherwise, compute the substrate correction as SEL = (m - 1.63) mg/cm^2, where "m" is as defined before.

SELs are applied as follows. For each component tested, subtract the SEL from the apparent lead concentration (ALC) (instrument reading taken in the TEST mode) to obtain the corrected lead concentration (CLC).

CLC = ALC - SEL

Table V-5. Suggested Surface Testing Sites

Interior

In each area (each room, closet, pantry, hall, part of a divided room, such as the dining area of a kitchen/dining room, etc.), the following surfaces are suggested for screening:

Baseboard	1 in each area
Ceiling	in each area
Crown molding	1 in each area
Door	surface of door and one side of the frame on a representative interior door in each area
Fireplace	-
Floor	1 in each area
Radiator	-
Shelf	1 in each area
Shelf support	in each area
Stairs	riser, tread, stringer, newel post, railing cap, balustrade
Wall	upper wall, lower wall, and chair rail (if applicable) in each area
Window	sash, casing, and sill on a representative window

Exterior

Bulkhead	-
Ceiling	-
Cornerboard	-
Door	surface of door and door casing
Fence	-
Floor	-
Joist	-
Lattice	-
Lower railing	-
Painted roofs	-
Porch	-
Railing cap	-
Siding	-
Stairs	tread, riser, and handrail
Support column	-
Trim	upper and lower
Window	sill, casing, and sash of a representative (also cellar window unit)

In single family testing, all measurements must also be substrate corrected. The corrections must be determined separately for each unit, because of the wide variety of substrates and construction materials encountered. The substrate correction protocol is the same as for multifamily testing, except that 3 representative samples of each substrate may be used instead of 9 in order to reduce the testing burden involved in separate substrate corrections for each unit.

Care must be exercised in obtaining substrate corrections. It is recommended that samples be taken in a place not generally visible. The paint should be carefully, but completely, removed on an area large enough to accommodate the face of the instrument. (The BEE should coordinate with civil engineering to repair all scraped surfaces, and to clean up any debris created by the sampling, since leaded paint may be involved.)

If the ALC exceeds 3 mg/cm^2, no correction is required. The quantity CLC (or ALC if greater than 3 mg/cm^2) is the value that is used by an inspector to classify each component when using an XRF analyzer.

Quality Control

Field qualilty control procedures are needed in XRF testing to protect against two kinds of instrument problems. The first is drift of the instrument's calibration, in which there is a systematic change over time in the average reading of the instrument. Drift invalidates the substrate correction, and results in bias in the substrate corrected measurements. The second problem is unusually high variability in the measurements. Quality control checks are needed to be sure that actual field variability remains in the expected range. Unusually high variability, resulting from causes such as humidity or temperature extremes, can substantially degrade the quality of the measurements.

To efficiently check for calibration drift, the inspector needs (in addition to the NIST Standard Reference Paint Films) a set of lead-control blocks of commonly encountered substrates: wood, plaster, metal, and concrete. Figure V-7 contains the recommended procedure for field quality control.

A quality control check for unusual variability must be performed every 20 measurements or every time the substrate changes. To perform the check, take an additional 2 measurements in the same place with the analyzer. The range (maximum - minimum) of the 3 measurements must not exceed 1 mg/cm^2. If it does, take 3 more measurements. If the range again exceeds 1.0 mg/cm^2, we conclude that the instrument is exhibiting unusual variability on this substrate. Suspend testing with the analyzer. Results for all samples measured since the last successful test for unusual variability should be discarded.

Interpretation of XRF Testing Data

Components are determined to be "positive" if the amount of lead-based paint on the paint surface exceeds 1 mg/cm^2. Because there is some uncertainty in the measurement obtained from portable XRF analyzers, the criterion for classifying components is based upon historical data about the size of the error and principles of statistics. The outcome of each test is the classification of each component as POSITIVE, NEGATIVE, or INCONCLUSIVE. The variability of the spectrum analyzer was found by independent analysis to be smaller than that for the direct readers. Therefore, the classification rules are different. The rules for the spectrum analyzer are as follows:

- A CLC of 1.3 mg/cm^2 or greater indicates that the component is POSITIVE.

- A component on which the CLC is less than 0.7 mg/cm^2 is classified as NEGATIVE.

- A component on which the CLC is between 0.7 and 1.3 mg/cm^2 is classified as INCONCLUSIVE.

The inspector is required to record each measurement for each component, and to indicate whether that component is classified as POSITIVE, NEGATIVE, or INCONCLUSIVE. At the end of the testing process, these results will be tabulated to determine if LBP is present.

Multifamily Units

The first step in interpretation of data involves the preparation of an XRF (spectrum analyzer) Testing Report. The report is aggregated over each Group of Similar Buildings and has a format as in the illustration below (notice that the number of tests varies by component):

Component	Number Tested	Positive	Inconclusive	Negative
Baseboards	275	30%	10%	60%
Walls	275	0%	5%	95%
Doors	55	13%	15%	82%
Shelves	110	2%	20%	78%

Decision rules for the inspectors depending on the percentages of components classified as POSITIVE, NEGATIVE, or INCONCLUSIVE. The rules are applied to each component separately, and depend on the type of XRF analyzer used.

The rules for determining whether there is a need for abatement or further testing in a building group are given in Table V-6 and Figure V-8.

Applying the decision rules to the illustration, we see that Rule 1 leads to the decision that baseboards and doors have lead-based paint. Because of the high percentage of negatives and the low percentage of inconclusive, testing all components, rather than abating all components, may be the preferred strategy. Rule 3 leads to the decision that walls and shelves require confirmatory testing.

Should the results of the decision analysis indicate that confirmatory laboratory analysis is required, it is the responsibility of the inspector to prepare the samples for an accredited laboratory. Good sampling practices for paint chip sample collection procedures are located in Appendix 5.

Results are then compared to the list of components likely to contain LBP. If the results agree, no further testing is necessary. Also further testing should not be required if components expected to be negative turn out to be positive. However, if results from any of the components expected to contain LBP are negative, further testing will be necessary to confirm the results obtained. In this situation, use the sample size required in Table V-1 to calculate the additional number of units that must be inspected for this component.

Table V-6: Classification of XRF Spectrum Analyzer Testing Results

Rule 1	If more than 11% of XRF results for a component are positive, lead is present, and either all such components should be abated, or all should be tested to determine which require abatement and which do not. If the testing option is chosen, all inconclusive results must be confirmed by laboratory analysis.
Rule 2	If all XRF results are negative and none are positive or inconclusive, no abatement or further testing of that component is required.
Rule 3	If less than or equal to 11% of the XRF results are positive or at least one result is inconclusive, laboratory confirmatory testing is required. All positives XRF results, and all inconclusive readings above 1.0 mg/cm^2 must also be confirmed.
Rule 4	If confirmatory testing confirms the presence of LBP above the action level on a component, lead is present. The inspector has the same options as under Rule 1 - abate or test all components.

Using the previous example, let's assume that the shelves were expected to be positive. After XRF and confirmatory testing, all results were less that 1 mg/cm^2 or 0.5% by weight so it can be concluded that LBP is not present. However, based on the sample size used (Table V-3), we can only assume that less that 20% of units inspected were leaded and probably one was not chosen for inspection. Therefore, the sample size should be increased to provide a 95% chance that if 5% of the units have shelves with lead paint at least one unit is selected for inspection. Assuming that the total number of similar buildings is 30, 23 units should have their shelves inspected (Table V-1). But, 11 units were already sampled, so 12 randomly selected additional units should have their shelves inspected. The percentage of positives, inconclusives, and negatives will then be recalculated for shelves.

Figure V-9 summarizes the LBP sampling strategy from visual inspections through comprehensive testing.

Scattered Site Housing

Testing in single-family or scattered site housing differs from multifamily unit testing in that the decision to abate is based upon sampling in a single unit. For multifamily testing, certain units are selected for sampling and, within each of those units, all surfaces are tested. For scattered-site units all surfaces must be tested. The surfaces to be tested are the same ones listed for units of multi-family dwellings. Knowledge of the painting history of the unit to be tested will help to identify those components that may be highly leaded. However, all components should still be tested as specified in the guidelines.

There has been some interest in introducing statistical procedures to lessen the cost of sampling for single-family or scattered site housing. In response, EPA is studying such approaches. However, as of this writing, no specific alternative sampling procedures have been proposed. The HUD Interim Guidelines recommend that testing for single-family or scattered site housing be done using a spectrum analyzer XRF or laboratory analysis. Direct reading XRF analyzers are not recommended for these dwellings because many test results will very likely be inconclusive and will require laboratory analysis for confirmation. Also, the decision rules for multifamily housing do not apply for single-family housing, so that the number of tests required is greater.

When a spectrum analyzer is used for testing of single-family housing units, substrate correction is also recommended. The following rules apply for abatement decisions when a spectrum analyzer XRF is used. All spectrum analyzer results are reported with the substrate correction. Notice that CLC's less than or equal to 0.3 mg/cm^2 for the spectrum analyzer are regarded as negatives. Thus less confirmatory testing will be required with the spectrum analyzer.

- CLC values greater than or equal to 1.3 mg/cm^2 are considered positive.

- CLC values less than or equal to 0.3 mg/cm^2 indicate that no lead is present at or above the regulatory level of 1.0 mg/cm^2.

- CLC values between 0.3 and 1.3 mg/cm^2 require confirmatory testing.

Confirmatory testing can be accomplished by submitting samples for laboratory analysis.

Address:______________________________ Date of Survey:______________

Date of Construction:______________________________ Temperature:______________

Total Number of Rooms:__________ # of Bedrooms:__________ # of Bathrooms:__________

# of Doors:__________ # of Windows:__________

NOTES:____

____

____

HOUSE PLAN:

Room Descriptions:

#1	______	#5	______	#9	______
#2	______	#6	______	#10	______
#3	______	#7	______	#11	______
#4	______	#8	______	#12	______

Survey Completed by:______________________________ Signature:______________________
Name/Grade/AFSC

Figure V-1. Lead-Based Paint Sampling Plan

# of Windows:______________________ # of Doors:______________

XRF Model/Serial #:______________________

NOTES:

____

____

EXTERIOR PLAN: Dimensions: Width:________ft./Height:________ft./Length:________ft.

ID#	Component	Location	ID#	Component	Location

Survey Completed by:______________________ Signature:______________________

Name/Grade/AFSC

Figure V-2. Exterior Sampling Plan

Room Number:________________ XRF Model/Serial #:________________________

Floor Level:________ # of Windows:________ # of Doors:________

NOTES:

____

____

ROOM PLAN: Dimensions: Width:________ft/Height:________ft/Length:________ft

ID#	Component	Location	ID#	Component	Location

Survey Completed by:______________________________ Signature:______________________________
Name/Grade/AFSC

Figure V-3. Interior Sampling Plan

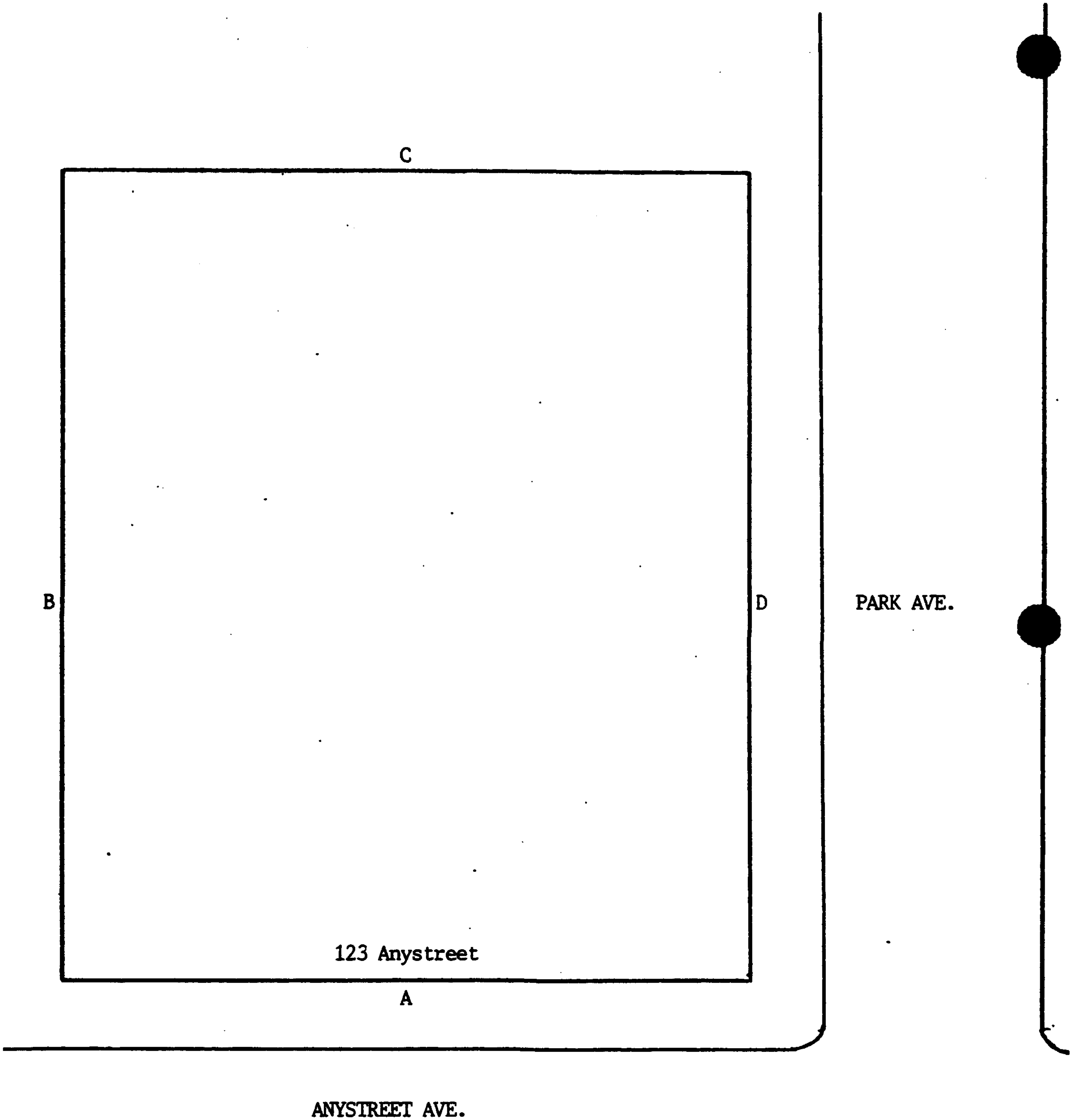

Figure V-4. Example of Wall Identification

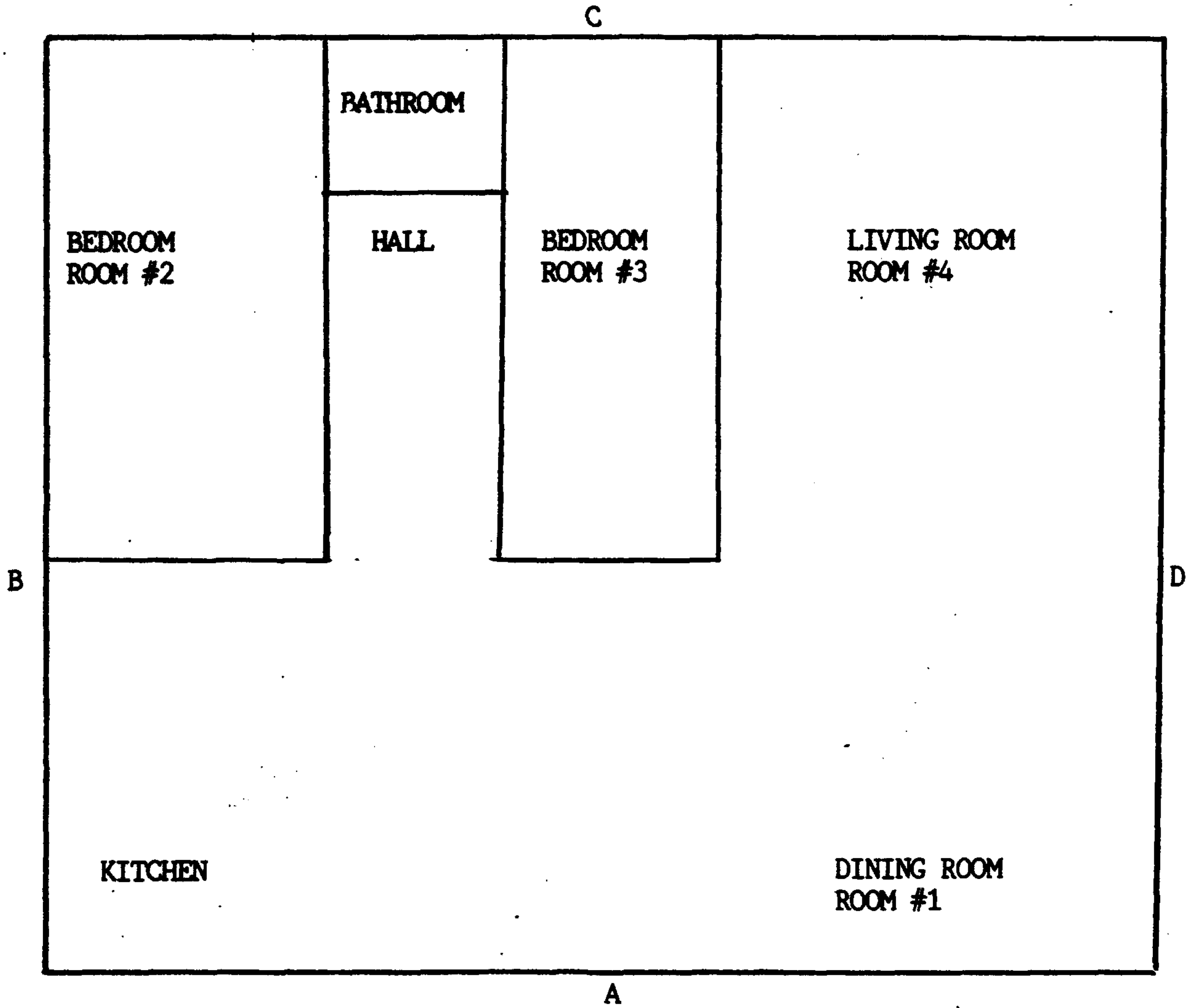

Figure V-5. Example of Room Numbering Techniques

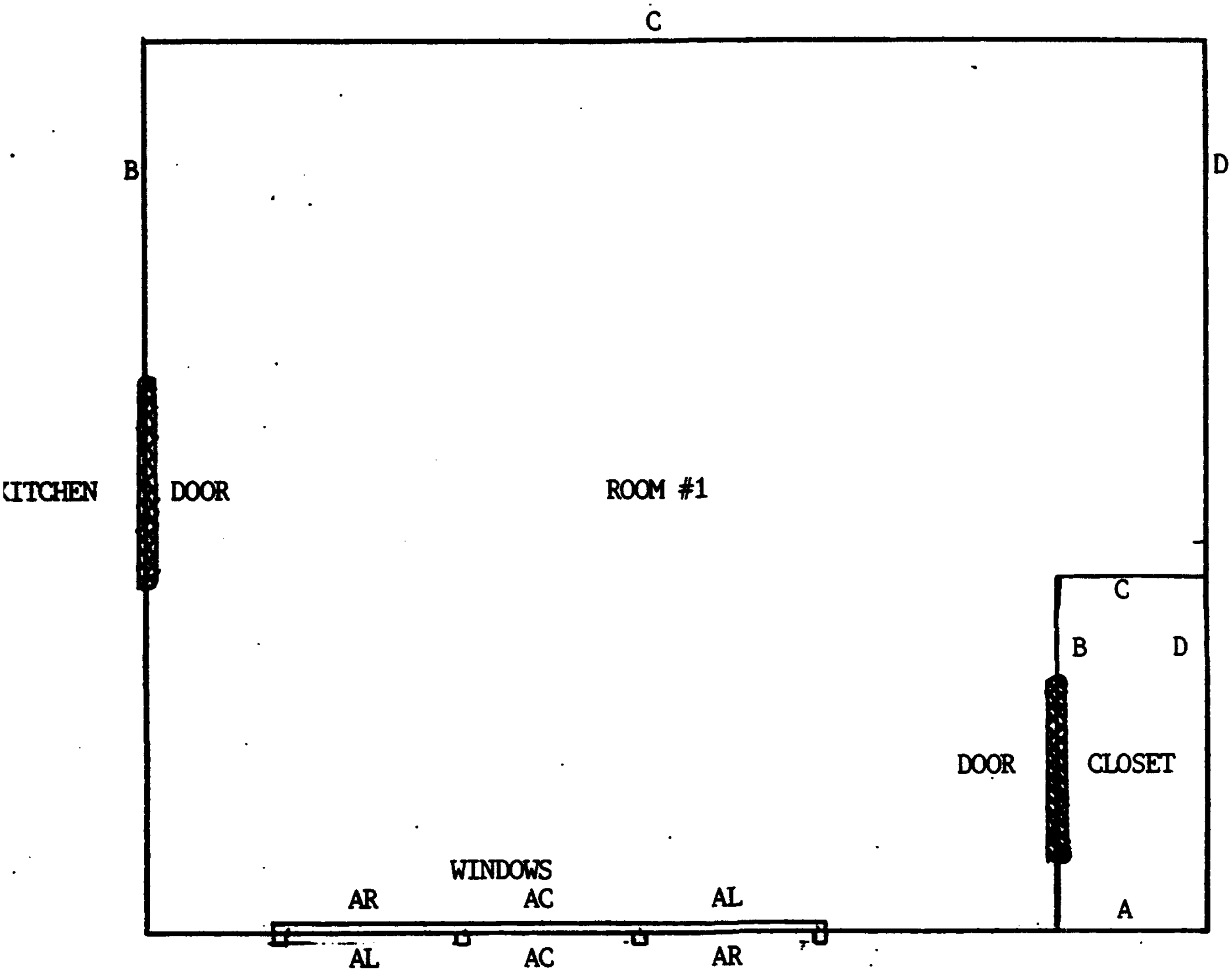

Figure V-6. Suggested Method for Identifying Surfaces Within a Room

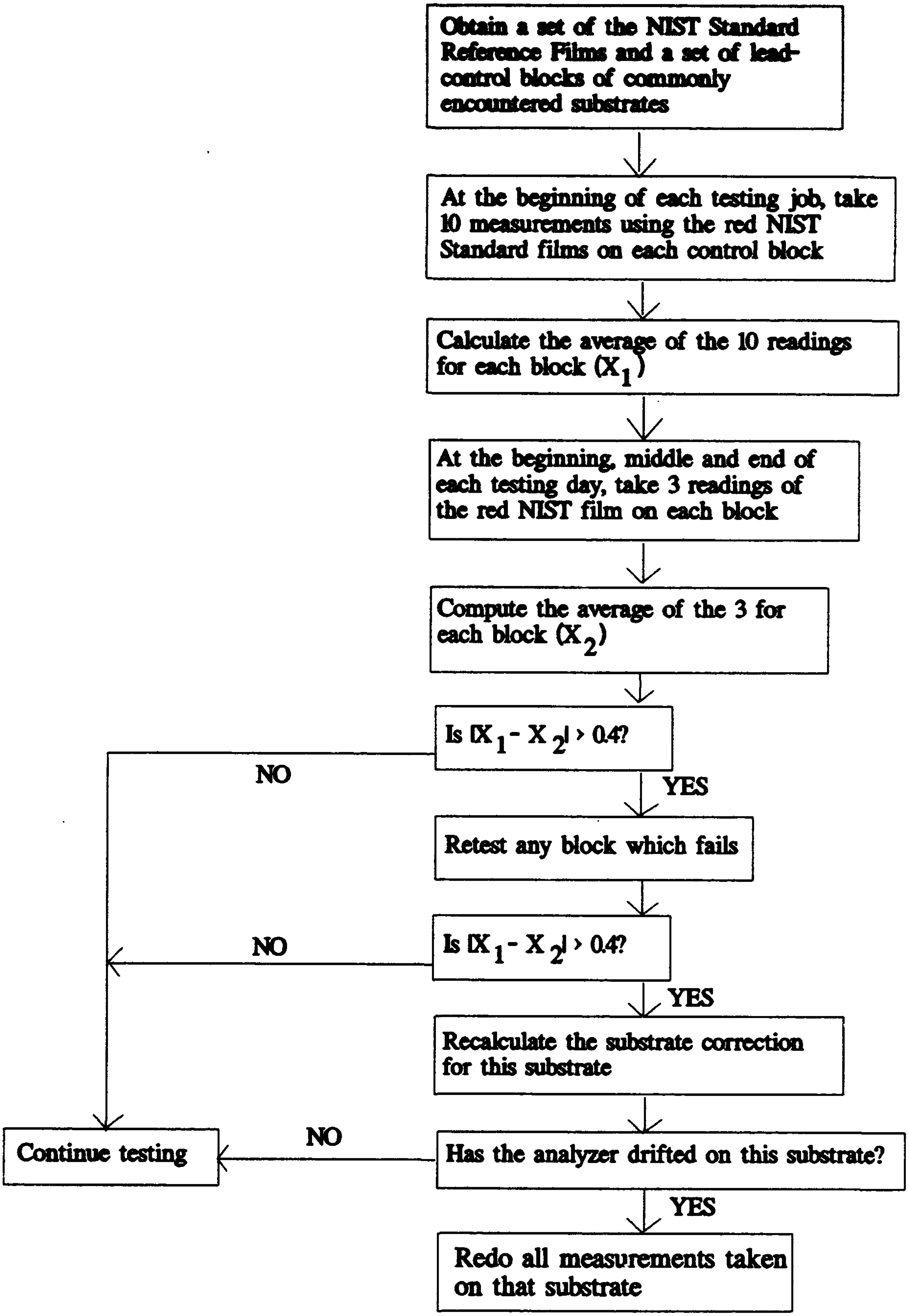

Figure V-7. Field Quality Control Procedures for the XRF

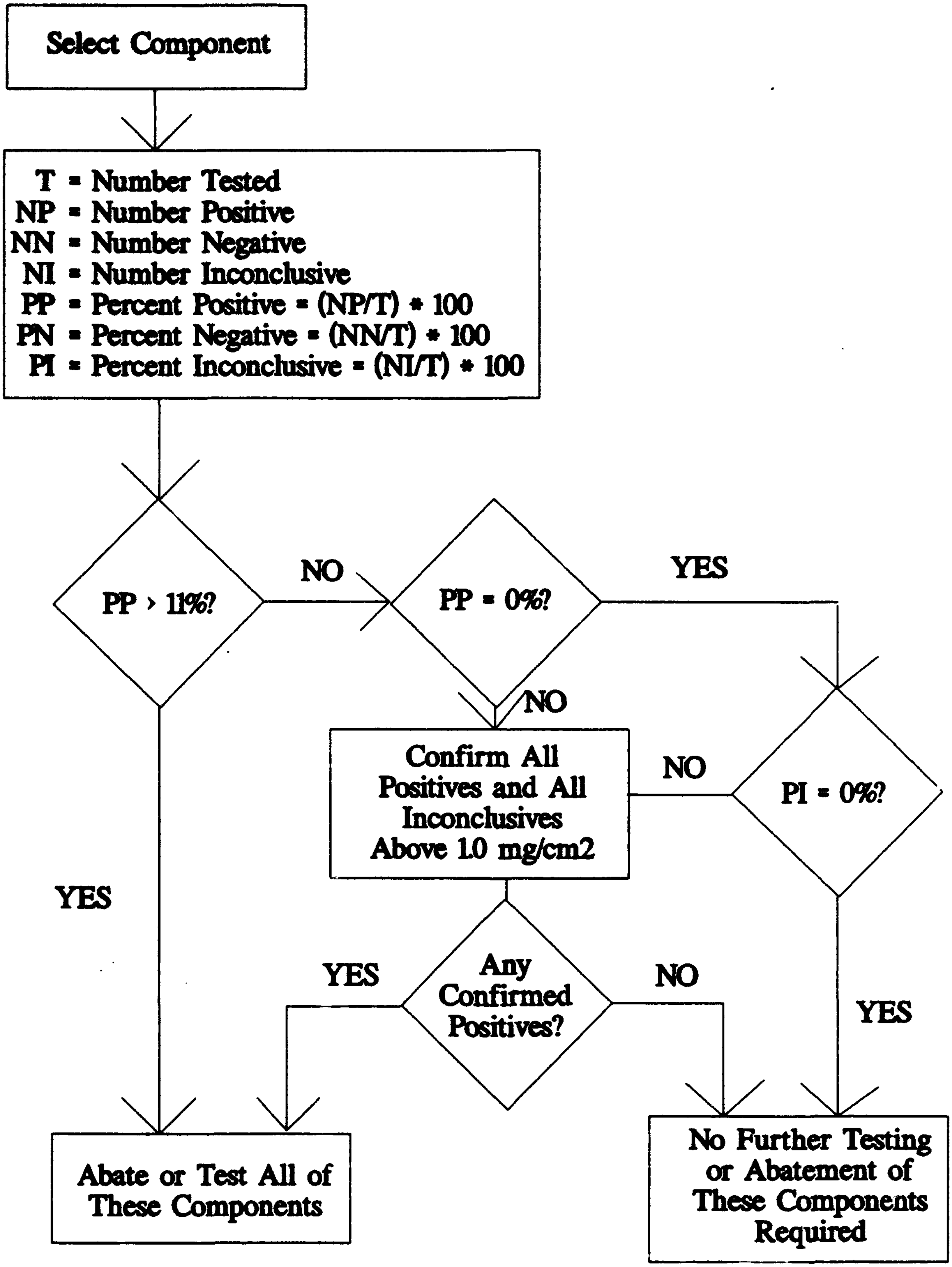

Figure V-8. Flowchart of Decision Rules for Multiunit Testing with a Spectrum-Analyzer XRF

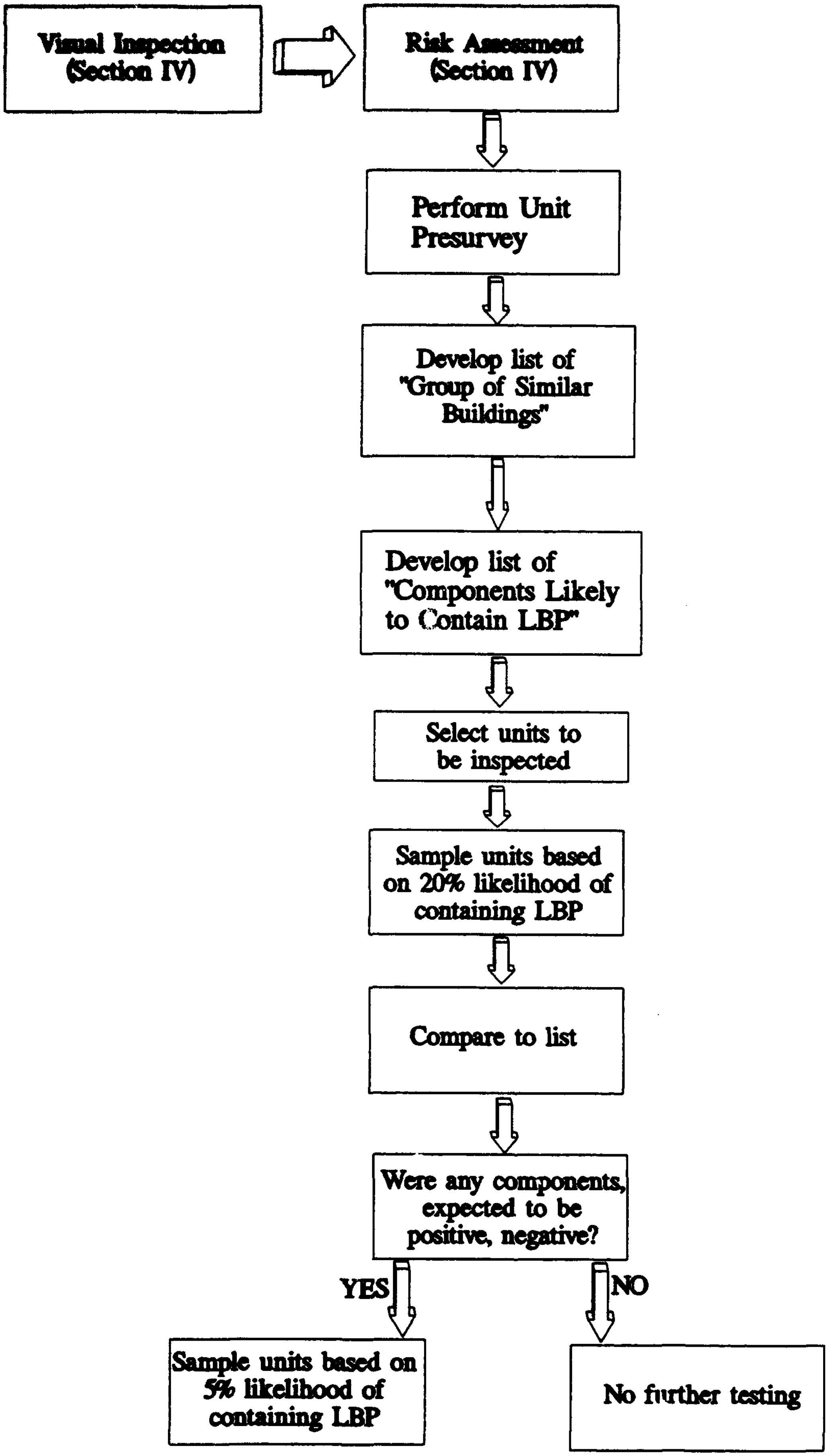

Figure V-9. LBP Sampling Strategy

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Department of Housing and Urban Development. Lead-Based Paint: Interim Guidelines for Hazard Identification and Abatement in Public and Indian Housing. Publication # PB91-144311. September 1990

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SECTION VI

IN-PLACE MANAGEMENT

Principles

The first step in the facility Lead Program should be the development of the base management plan. An effective and successful management plan cannot be developed unless the long-term and short-term objectives are identified. This will require a commitment of all players involved (CE, BEE, JA, MPHO, etc.). Some examples of the long- and short-term objectives that may be considered are shown in Table VI-1.

Table VI-1. Objectives in LBP Management Planning

Short-Term Objectives	Long-Term Objectives
• Reduce Exposure to Hazards	• Eliminate Exposure to Hazards
• Aesthetics	• Energy Efficiency
• Regular and Routine Maintenance	• Aesthetics
• Unit Use Upgrades	• Future Renovations
• Economics	• Future Use
• Manpower Available	• Economics
• Immediacy of Hazards	• Manpower Available

The decision to perform abatement or to manage the identified hazards in-place should be based upon several factors, as follows:

1. The number of skilled and properly trained in-house abatement workers or abatement contractors that are available

2. The estimated cost of full-scale abatement

3. The condition of the substrates that the identified hazards are on

4. The amount of time that abatement will take

5. The availability of alternative housing for displaced residents

6. The estimated cost of in-place management

7. The estimated cost to relocate occupants prior to and after abatement

8. Future planned use of the structures

9. Availability of funding

10. The predicted amount of hazardous waste that would be generated

11. The degree of risk of occupant exposure to lead poisoning hazards

12. The amount of occupant training that will be necessary to perform in-place management versus worker training needed for abatement

13. The amount of available abatement equipment and materials

14. Long- and short-term objectives

Figure VI-1 shows a cost comparison for LBP-related activities.

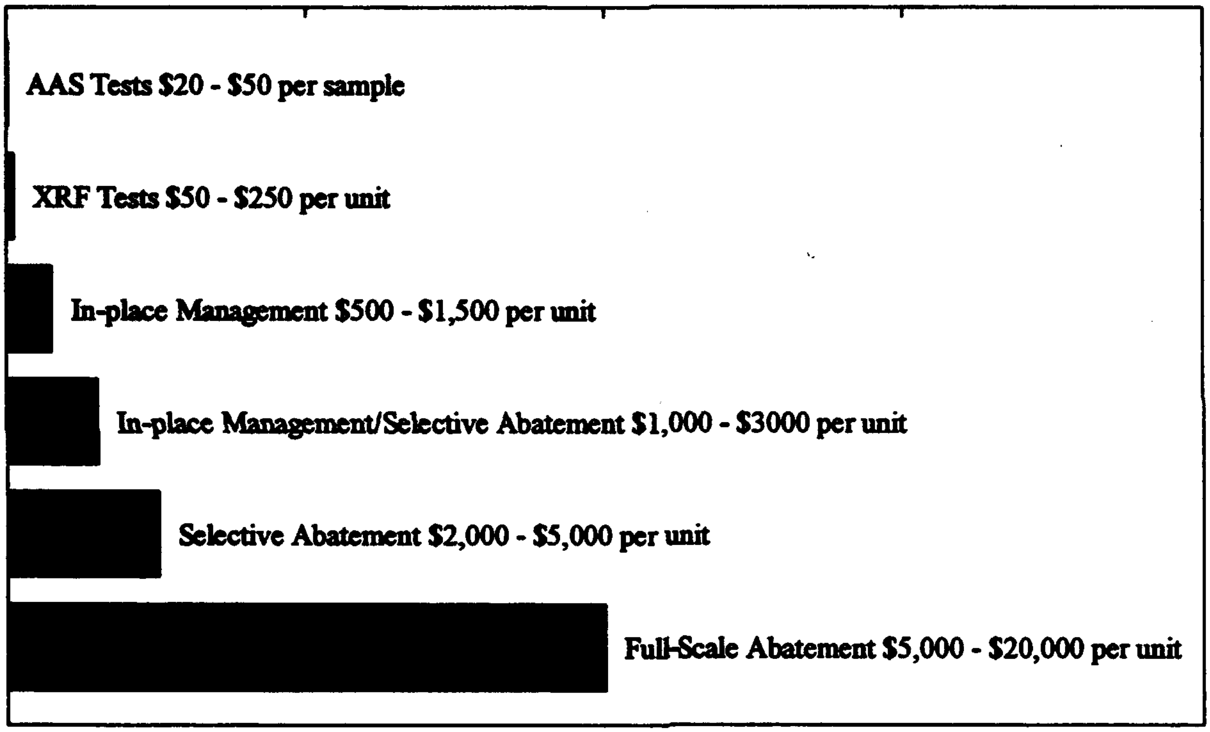


Figure VI-1. Lead-Based Paint Cost of Work Comparison

In-Place management (IPM) measures are designed to meet needs in three general situations. First, in-place management should be instituted to clean up lead paint and dust lead hazards identified through the course of risk assessments (for facilities where full abatement actions are not possible in the near future). In this scenario, in-place management amounts to corrective measures specifically designed to clean up hazardous lead paint chips and dust in high priority facilities. In addition, in-place management involves taking steps to stabilize the situation to prevent continuing or future lead exposures.

Second, in-place management means preventing acceptable situations from deteriorating to create excessive lead exposures in the future. In this sense, in-place management amounts to preventive

management and periodic cleaning. Surfaces known or suspected of being covered with leaded paint should be monitored. If it is suspected that lead dust levels may be increasing, periodic cleanups should be done to keep lead dust from accumulating to dangerous levels on accessible surfaces such as windowsills (stools) and floors.

Third, in-place management requires that precautions be taken to avoid inadvertently disturbing lead-based paint or otherwise creating lead dust hazards in the course of other maintenance, repair or modernization work. Any work disturbing lead-based paint has the potential for generating lead dust. Obviously, the level of risk is a function of the scale of the work and the amount of dust generated, but it does not take much lead dust to poison a child or adult. All maintenance, repair, or modernization work encountering paint should be carried out carefully to avoid creating lead hazards. As a minimum, in-place management will include a rigorous cleanup at the conclusion of any repair project which disturbs lead-based paint.

Worker Protection

Worker protection is an important aspect of the in-place management program. It is essential that all workers involved in reducing lead-based paint hazards receive training in the hazards of lead, proper procedures and work practices, and the need for protective equipment and proper hygiene. Great care must be exercised to protect workers from excess lead exposures and to prevent them from taking lead dust home on their clothing or belongings.

Workers conducting in-place management projects to correct hazards found during risk assessment should wear the full protective equipment recommended for abatement work until it can be determined the workers are not exposed to lead concentrations exceeding the occupational exposure limit. This includes: coveralls; shoe coverings; hair covering; gloves; safety goggles; and a properly fitted respirator. Workers must not eat, drink, or smoke on the job; hands and face must be washed before breaks and at the end of the workday. Work clothes must not be worn home.

Activities related to preventive maintenance, such as normal repainting, and routine cleaning may be carried out with lesser protection, depending on the scale of the project and the potential for exposure. Workers engaged in other renovation or repair projects which may encounter LBP must be protected from exposures and must take the necessary precautions to control, contain, and cleanup dust. The level of protection and controls should be keyed to the scale of the project and its potential for lead dust generation. Section VII, Abatement and Cleanup provides information on the potential dust generation of the different repair techniques.

All construction work, including demolition, routine maitenance, and in-place management with the potential of disturbing LBP are required to comply with the new Interim Final Rule of Lead in Construction. Refer to Section VII for more information on the requirements of this standard.

Area and Resident Protection

Housing residents should not be permitted in the unit or in the vicinity of the job (based on the magnitude of the job) while corrective actions are being carried out. Residents' belongings should be protected from possible exposure to lead dust released during the project.

In most cases, it may be possible to conduct preventive maintenance and repair projects while residents remain in their homes. Care should be exercised to keep residents and their children away from the work area and to protect their belongings from possible lead dust contamination.

Loose, peeling/flaking material should be removed from the surface(s) by wet scraping the surface(s) to obtain a smooth cleanable surface that can be repainted. During the course of wet scraping, the debris should be gathered with a wet/dry vacuum as often as necessary to minimize dispersion. Also, it may be necessary to spray or rewet fallen debris to keep it in one place.

Interior Surfaces

Furnishings and personal belongings that remain in the room or space are to be protected with polyethylene covering. The work area should be sealed from the rest of the residence. Residents entry to the room/space is to be prevented until cleanup has been completed at the conclusion of the work. In most cases in which more than a single workday is required to complete the job, it will be cost effective to permit residents to return to their dwellings each night or in cases where only part of the unit was isolated and the family needs to get access to it at the end of the day (i.e., kitchen, bathroom, etc.). In these cases, a complete cleanup will be required at the end of each workday before residents are permitted to return to the space or room. Figure VI-2 presents in-place management procedures for interior surfaces.

Exterior Surfaces

All surfaces immediately adjacent to and below the work area(s) should be protected with a 6-mil polyethylene film to protect ground and shrubbery, and to retain wet debris and dust that will be created during the surface treatment. Figure VI-3 presents in-place management procedures for exterior surfaces.

Lead in Soil

Children playing outdoors may be exposed directly to the lead hazards in the soil. Paved walkways, outdoor steps and landings, and recreation and play equipment are likely to have accumulations of leaded dust.

Lead dust from exterior sources can easily be carried into buildings on shoes and clothing, or it may blow into dwellings through open windows and doors. As part of normal play and hand-to-mouth activities, young children may inhale or ingest lead from soil or dust. Ingestion of dust and soil during meals and playtime activity appears to be a more significant pathway than inhalation for young children.

Until data demonstrating the efficacy and cost-effectiveness of permanent soil and dust abatement measures are available, interim risk reduction steps may be justified in some locations. If bare or exposed soil adjacent to buildings, on walkways to buildings, in automobile parking areas, and in children's play areas contain lead in excess of 500 parts per million, and a lead-dust concentration exceeding the cleanup criteria (Section VII) is identified, then additional precautions should be considered to protect buildings' occupants and maintenance workers from contaminated exterior dust. Covering lobby and entry floors with indoor/outdoor carpeting will help reduce tracking of dust into the building. Door mats and floor coverings should be maintained and cleaned on a regular schedule.

Removal of accumulated dust should be by High Efficiency Particle Air (HEPA) filter equipped vacuum.

In dry weather, exterior walkways, steps, and landings should be washed with water to flush dust away. Playgrounds, exterior recreational equipment, and outside seating that is in the vicinity of contaminated soil should also be flushed periodically.

Since the highest concentrations of lead in the immediate vicinity of housing generally occurs near surfaces that were once painted with lead paint (like exterior walls), consideration should be given to planting shrubbery around the building so children cannot play in the area.

Soil contaminated with lead should be isolated from the residents by establishing an effective barrier between them. The following are effective means of limiting exposure to dust originating from lead contaminated soil (Figure VI-4):

1. Grass cover, whether from seed or sod, if properly maintained

2. Covering the bare ground with sand and/or wood chips, if properly contained at perimeters, and maintained

3. Hard surface paving over contaminated soil

4. Restricting access to contaminated soil with warning signs and appropriate fencing.

Cleanup

Cleanup is one of the most important components of any in-place management project. Unless great care is taken to cleanup debris, paint chips and lead dust, the dwelling may be more hazardous after treatment than it was before. Cleanup becomes especially important after any renovation, construction, in-place management, or abatement is performed in high priority facilities.

At the end of each day, dust and debris should be cleaned up and removed. Debris should be misted with water prior to sweeping and then placed in double 4-mil or 6-mil plastic bags. A HEPA vacuum should be used to pick up remaining dust.

At the end of corrective action work (or repair work which generates significant amounts of lead dust), cleanup consists of three steps:

1. Remove all surface dust and small debris with a HEPA vacuum.

2. Wet wash using a high-phosphate (containing at least 5% trisodium phosphate [TSP]) detergent. Care should be taken each time the cleaning mixture is exchanged to ensure that dirty water is not allowed to contaminate surfaces.

3. A final HEPA vacuuming

After the cleanup is complete, the unit or work area should be tested to ensure that hazardous amounts of lead dust are not left behind. Clearance testing procedures and criteria are discussed in Section VII, Abatement and Cleanup.

Preventive Maintenance

The intensity of the cleanup should be based on the scale of the maintenance or repair project and the amount of lead dust generated. If a repair project generates extensive lead dust, the full cleanup procedures recommended above for corrective actions should be followed. In other cases, traditional cleanup procedures can be used, with additional emphasis on lead dust. Wet mopping or wet wiping with TSP detergent should be a routine cleanup procedure for projects which generate even small amounts of lead dust.

Follow-On Monitoring

Facilities covered by in-place management should be reinspected periodically to:

1. verify that previously restored surfaces remain in sound condition

2. identify the occurrence and extent of additional painted surface failures

3. check for the presence or recurrence of excessive dust and assess the quality of housekeeping

Residents should be encouraged to report any deteriorated paint.

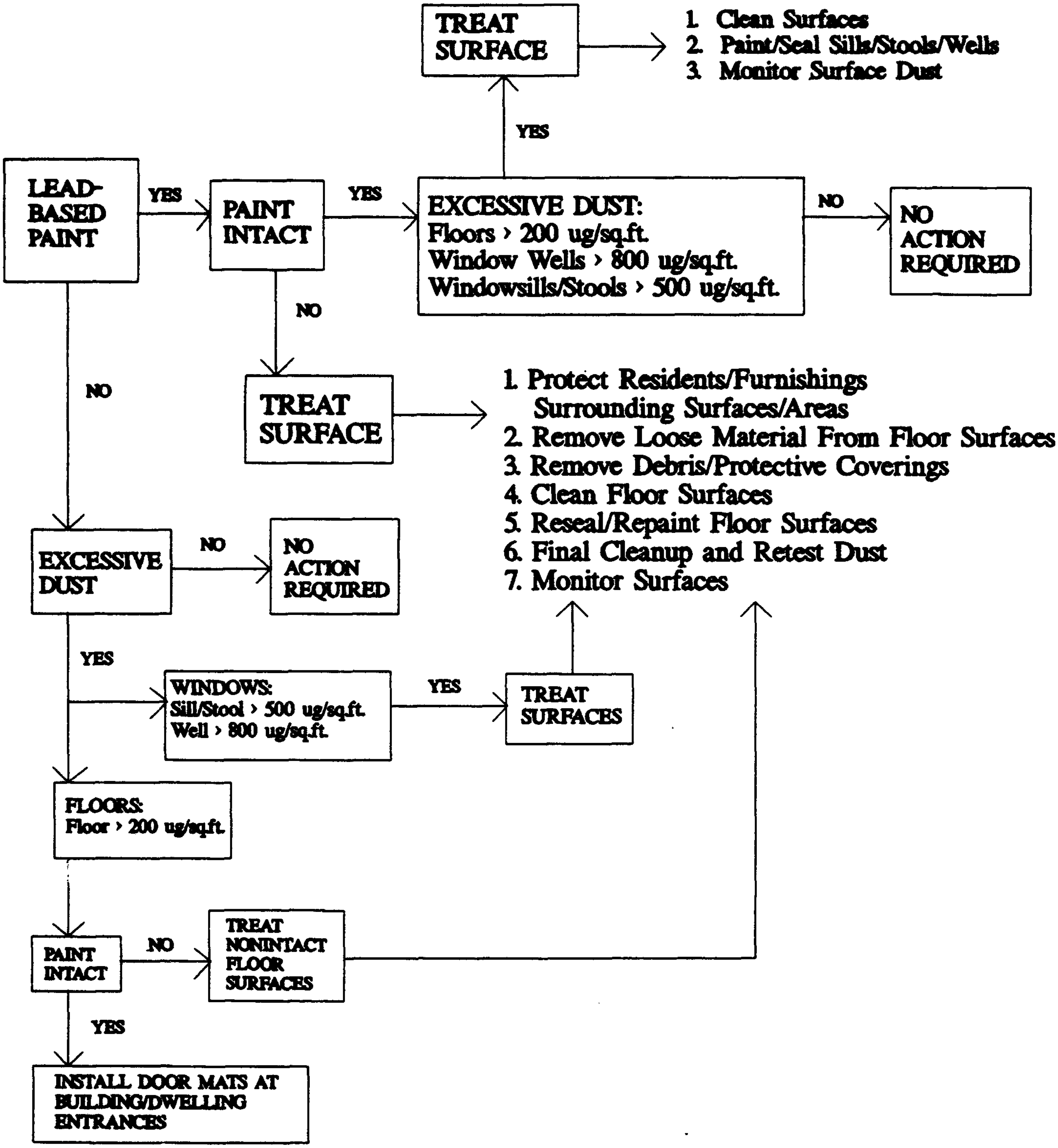


Figure VI-2. In-Place Management Procedures for Interior Surfaces

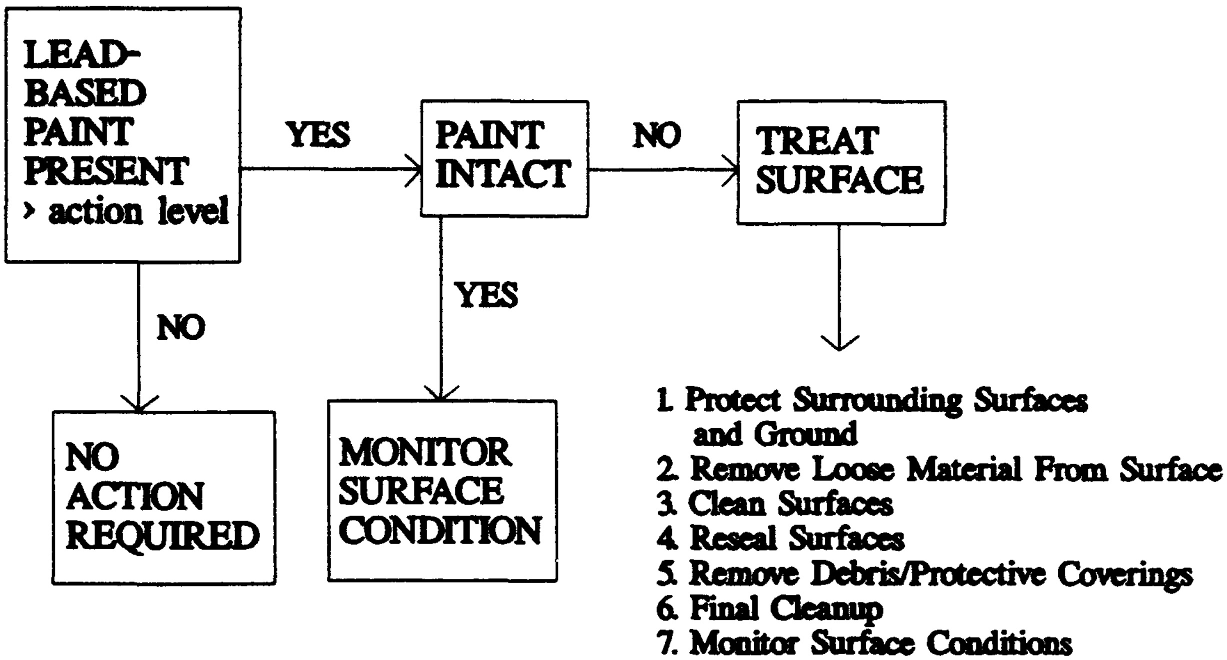
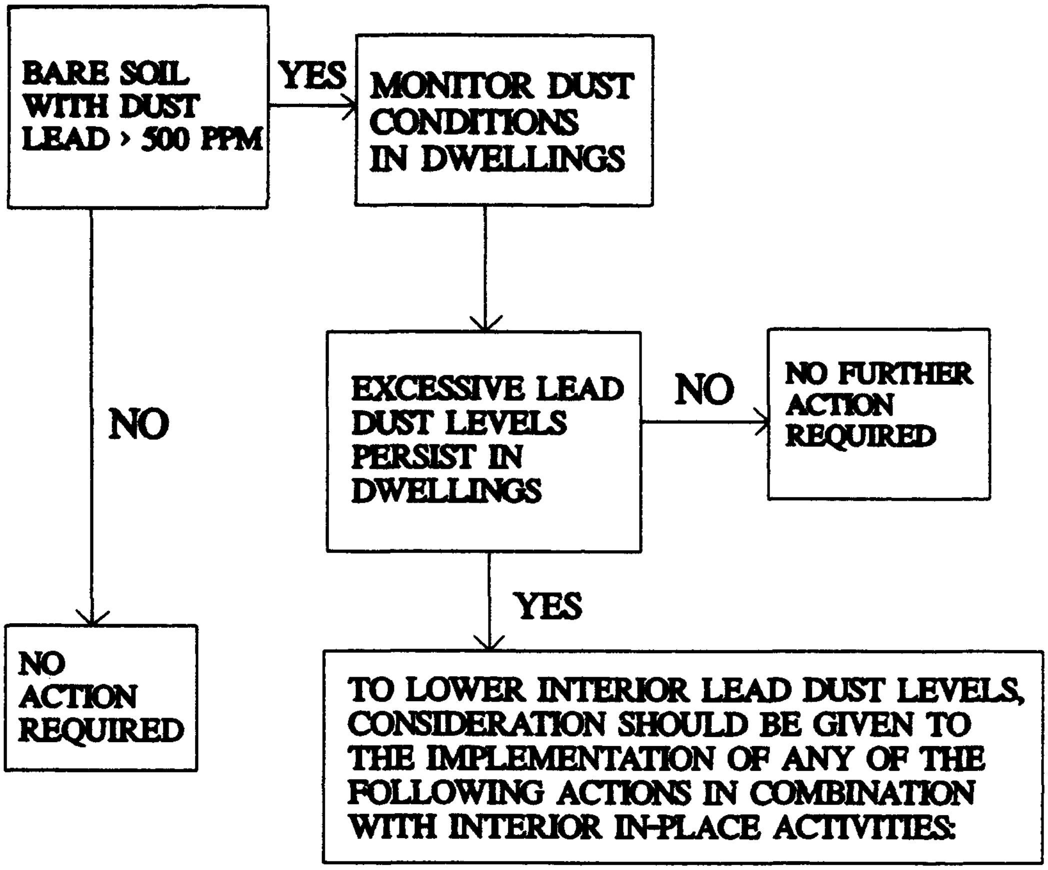


Figure VI-3. In-Place Management Procedures for Exterior Surfaces



1. Provide Grass Cover, (Seed or Sod)
2. Cover Bare Ground With Sand and/or Wood Chips
3. Provide Hard Surface Paving Over Bare Areas
4. Restrict Access to Contaminated Areas

Figure VI-4. In-Place Management Procedures for Bare Soil

References

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SECTION VII

ABATEMENT AND CLEANUP

Selection of Abatement Procedures

The aim of the approach to abatement is to safely and cost-effectively reduce exposure to interior and exterior lead-based paint and lead dust in order to better protect children and families from irreversible effects of lead damage.

The most important elements of this approach include:

- carefully selecting a cost-effective abatement strategy,
- relocating or protecting occupants and protecting workers during abatement,
- using containment and careful work practices during abatement to minimize hazards and ease cleanup,
- ensuring careful post-abatement cleanup,
- barring reoccupancy until specified clearance criteria are met.

The necessity of minimizing lead dust generation during abatement may not be immediately apparent. There is concern that large amounts of fine lead dust will be difficult to clean up well enough so that abated units meet the reoccupancy clearance standards. It always makes sense to be careful about generating lead dust during abatement, but dust generation is only one factor to be weighed in deciding on an abatement strategy. Abatement is safe if:

- workers are properly protected,
- the unit is unoccupied or occupants are protected,
- containment is in place during abatement,
- units are cleaned well enough to meet reoccupancy clearance criteria.

The three general strategies for lead paint abatement are:

- Replacement
- Encapsulation/Enclosure
- Paint Removal

Each method has advantages, disadvantages, and costs to consider when planning for abatement. In many instances, it may be necessary to use more than one of these strategies in a single housing unit. The advantages and disadvantages of each method are outlined in Appendix 9.

Replacement

Replacement means the removal of components such as windows, doors, and trim that have lead-painted surfaces and installing new components free of lead-containing paint. Removal without reinstallation of new components may be an option for certain components (e.g., shelving). The removal phase has the greater potential for generation of lead dust and debris and will require close attention to worker health and safety.

Replacement can be done on many exterior and interior components, exceptions being most walls, ceilings, and floors. Replacement has the advantage of allowing for a permanent solution. It is also beneficial for the following reasons:

- Ease of meeting post-abatement clearance standards
- May integrate well with renovation and modernization projects
- Increase energy efficiency, for example if replacement windows are more energy efficient than the original windows
- May be the easiest and quickest way to perform abatement on doors, windows, and trim.
- Allows for the upgrading of components

The following aspects of replacement efforts should be kept in mind:

- Replacement may damage adjacent surfaces (e.g., plaster walls when baseboards are removed).
- Reinstallation of certain components requires labor skilled in carpentry.
- A large volume of solid waste may be created which may or may not be considered hazardous waste.
- Nonstandard replacement parts may require special orders which may require additional ordering time.

Replacement is not the strategy of choice when it is prohibited by local, state, or federal requirements for the historic preservation of the older housing. Similarly, replacement is not an appropriate strategy for a restoration project that aims to preserve original components and surfaces. Replacement may not be appropriate for buildings that will be demolished or otherwise removed from the housing stock in the near future.

Encapsulation

Encapsulation means making lead paint inaccessible by covering or sealing painting surfaces. This strategy provides relative long-term protection and does not require routine maintenance to ensure the integrity of the encapsulant. Methods currently exist to encapsulate interior and exterior walls, pipes, and trim.

If surfaces are peeling or deteriorating and scraping is necessary prior to encapsulation, this method will produce lead dust and debris. If encapsulation is being used over a surface covered with intact paint, little dust is generated. Also, encapsulation may be faster than other methods.

Little is known about the durability of encapsulants. The National Institute of Standards and Technology is currently evaluating the durability of several encapsulants.

Enclosure

Enclosure is resurfacing or covering of surfaces by mechanically affixed durable materials. This strategy provides a relatively long-term protection. Typically, it does not require regular and routine maintenance to ensure the integrity of the enclosure material.

The durability of some enclosure materials, such as gypsum dry wall and exterior siding, is well known. Quality installation of these materials, however, requires skilled workers and may be more expensive than other forms of encapsulation.

The following materials should not be used as encapsulants:

- A new coat of paint or primer
- Paper wall coverings
- Contact paper
- Any similar nondurable material

Paint Removal

Paint removal means stripping the lead paint from the surfaces of components. There are two types of paint removal: on-site and off-site. The on-site use of the following paint removal methods should be restricted to limited surface areas (e.g., jambs, balustrades, and decorative or ornate items):

- heat gun
- sanders equipped with HEPA vacuum filtration
- caustic chemical and solvent-based strippers
- scraping with misting

Generally, chemical paint removal methods work best on metal substrates. (Caustics are not recommended for use on aluminum.) Metal substrates also may make cleanup of residual lead easier, since their surfaces are usually smooth and nonporous.

All substrates abated by paint removal methods should be repainted and sealed. Compared to flat paint, high gloss lead-free paint makes it easier to control dust, it provides a smoother, easier surface to clean.

Heat-Based Removal Methods

High levels of airborne lead can be produced and dispersed by heat guns. At the temperatures expected to occur during paint removal operations with most currently available heat guns, some lead is likely to be vaporized. Considerable lead is vaporized creating lead fumes at approximately 700 degrees F. Heat guns able to reach temperatures in excess of 700 degrees F should not be operated in that temperature range.

On-Site Chemical Removal Methods

On-site chemical removal methods may require multiple applications depending on the number of layers of paint. Caustic and solvent-based chemicals should not be allowed to dry on the lead-painted surface. If drying occurs, paint removal will not be satisfactory and the potential for creating lead dust in the process will be increased. When the plastic is applied, care should be taken to cover and seal the edges and ends to prevent drying.

The process of washing and neutralizing substrates on which caustic chemicals have been used can create large quantities of lead-bearing liquid waste. Any surfaces that have contact with this liquid

waste should be cleaned by wet washing until there is no visible residue. Chemical stripping products containing methylene chloride should not be used.

Off-Site Chemical Removal Methods

Off-site chemical removal means the stripping of lead-paint from building component parts at the facilities of a professional paint stripping operation, where stripping of the paint takes place in chemical tanks. Components should be removed carefully to minimize damage to the parts themselves and surrounding surfaces. Prior to abatement, contractors should:

- Determine size limitations of the dipping tank.
- Arrange for same-day service for components needed for each unit's security.
- Discuss with the dipping subcontractor the procedures for washing components to remove any lead residues left behind on stripped surfaces.
- Label all components with punch marks or other permanent markings to facilitate reinstallation.

Even after the stripped components are washed, worker protection measures should continue to be implemented during handling and reinstallation to protect workers from exposure to any lead that remains on surfaces.

Mechanical Removal Methods

Scraping should be performed with misting to reduce exposure to fine airborne particulate. If sanding is required after scraping, a HEPA filtered sander must be used.

When using a sander equipped with a HEPA filtered vacuum, follow the manufacturer's operating instructions and instructions for care and maintenance. The potential for production of lead dust increases when the sanding disk is wider than the surface being abated (e.g., a door stop) because the sanding shroud is not always in contact with the surfaces. The HEPA sander is therefore recommended only for certain surface areas. Its use is most appropriate on flat surfaces such as jambs/stair risers.

Similarly, when using abrasive blasting with a vacuum on exterior surfaces, care should be taken that the configuration of the heads on the blasting nozzle match the configuration of the substrate so that the vacuum is effective in containing debris.

Factors Influencing Selection of Strategies

Overall Housing Conditions

Anyone planning to undertake lead-based paint abatement must also take into consideration the overall condition of the housing (e.g., grossly substandard, substandard, or well maintained).

Replacement is the strategy of choice for deteriorated housing if the building components are not salvageable. In substandard housing, substrates may be too deteriorated to support encapsulation or

enable paint removal. For example, a wall that is structurally unsound may not support an encapsulating system that uses framing or direct bonding agents. Furthermore, there is no point in removing paint from nonfunctioning nonrepairable components (e.g., dry rotted window sashes) or from deteriorated substrates that do not provide smooth, easily cleanable surfaces.

In some cases, the specific component and its state of repair will dictate the abatement method. For example, large wall surfaces will generally be encapsulated since paint removal on large surfaces generates high levels of lead dust. If a window is deteriorated and nonfunctioning, replacement should be the abatement method. An analysis of the condition and type of substrate material in a dwelling unit is particularly important for selection of removal and encapsulation methods. For example, a very deteriorated wall could not be effectively encapsulated with fiberglass materials if the new fiberglass is to be attached directly to the wall surface. Caustic chemicals would not be a good choice for removal if the lead-based paint is on an aluminum substrate.

Context of Abatement

The second consideration in selecting strategies is the reason for and context of abatement. When abatement is done in conjunction with modernization or renovation, replacement has obvious advantages because many of the same activities (i.e., window replacement) would already be planned and the only additional costs would be for containment and worker protection. Outside the context of modernization or renovation, however (i.e., when abatement is done in the dwelling of an EBL child) , the base may or may not decide to undertake renovation in conjunction with abatement. High dust generating methods are particularly disadvantageous when doing abatement in common areas of multifamily units and multifamily units themselves due to the problem of lead dispersal.

Criteria for Selecting Specific Methods

In many instances, it may be necessary to use more than one of the general strategies for any given abatement job. The planner should also consider the criteria for selection of specific methods of abatement that are described as follows.

Whenever possible, preference should be given to methods that create the least amount of dust, fume, or mist. If on-site paint removal methods are used, choose a removal method most appropriate for the substrate and the thickness of the paint layers. Next, consider any additional measures beyond the basic measures to contain dust and protect workers, adjacent units, and the environment.

Of the three basic abatement strategies, paint removal and demolition prior to replacement generally require the most stringent worker protection measures. In addition to protection from lead exposure, workers must be protected from the hazards of stripping agents (e.g., caustics, methylene chloride, solvents, and possible fires) and injuries resulting from the use of heat guns and scrapers.

High dust generating methods will require the most stringent measures to protect adjacent units. For example, vacuum blasting of exterior surfaces will require more containment than the encapsulation of lead paint on exterior surfaces. Whenever wind conditions exceed 15 miles per hour or whenever there is visible movement of debris beyond the containment area, shrouding should be constructed for vacuum blasting.

Whether generated from interior or exterior abatement, liquid waste and fine airborne particles are the most difficult wastes to contain. Note that when liquid waste dries, very fine lead-containing particles remain. Caustic paint removal methods and hydroblasting methods generate varying quantities of liquid waste.

All abatements generate waste. Liquid wastes are the most difficult to contain and dispose of. The type and quantity must be considered in selecting a particular abatement method and in planning for both containment and disposal. Disposal costs, as well as the costs of all other aspects of abatement, will influence the selection of abatement methods.

Costs

An obvious constraint for many bases will be cost. The total budget for an abatement project must include costs for worker protection, containment, occupant relocation, cleanup, and disposal. A number of factors affect these total costs:

- The need for skilled labor: In areas where skilled construction labor is in short supply, it will be costly to use methods that require skills such as window replacement, carpentry (to rebuild window frames and sills), and putting up dry wall.

- The length of the abatement process: The longer an abatement project takes, the more it costs. This is especially true if the base is paying for alternative housing (e.g., a hotel) for displaced tenants and storage of tenants' belongings during abatement.

- The need to take additional protective measures: Use of dust-generating methods may increase costs if it becomes necessary to take additional steps to ensure protection of workers and proper containment.

- The need for repeat cleanup to meet dust clearance standards: Use of dust-generating methods may increase costs if it proves difficult to meet reoccupancy clearance criteria without repeated cleanups.

The Air Force Civil Engineering Support Agency (AFCESA/EN) is developing a cost estimating guide for abatement of residential and industrial structures based on a parametric format. This document will be distributed to all MAJCOM BEEs and Civil Engineers in January 1994.

Worker Protection

The Residential LBP Hazard Reduction Act of 1992, mandated OSHA to issue an interim final regulation on lead in construction. As a consequence, OSHA recently issued an interim final regulation on lead, 26 CFR 1926.62 (FR Vol. 58, No. 84, Tuesday, May 4, 1993). The standard covers several different occupations in the construction industry, including: demolition or salvage of structures where lead or lead-containing materials are present; removal or encapsulation of lead-containing materials; new construction; alteration, repair, or renovation of structures that contain lead or materials containing lead; and, installation of products containing lead. This standard reduces the lead permissible exposure limit for construction workers from 200 $\mu g/m^3$ to 50 $\mu g/m^3$ as an 8-hour

TWA. Also, an 8-hr TWA action level of 30 $\mu g/m^3$ is established as the level at which employers must initiate certain compliance activities.

If lead is present in the workplace in any quantity, the employer is required to make an initial determination of whether any employee's exposure to lead exceeds the action level. The standard lists tasks which may likely result in exposure to lead in excess of the PEL. If any of these tasks are performed in the workplace, the employer must provide the employee with appropriate respiratory protection, protective clothing and equipment, change areas, hand washing facilities, biological monitoring, and training; until such time that an exposure assessment is conducted which demonstrates that the exposure level is below the PEL. These tasks are divided into three categories based on anticipated air lead levels.

Level 1 includes those tasks expected to exceed the PEL but not higher than ten times the PEL (50 $\mu g/m^3$ to 500 $\mu g/m^3$). These are:

- manual demolition of structures (e.g., dry wall); manual scraping; manual sanding; heat gun applications; and power tool cleaning with dust collection systems when lead containing coatings or paint are present;

- spray painting with lead paint

Level 2 includes those tasks expected to create air lead levels between 500 $\mu g/m^3$ and 2500 $\mu g/m^3$. These are:

- using lead containing mortar; lead burning

- where lead containing coatings or paint are present: rivet busting, power tool cleaning without dust collection systems; cleanup activities where dry expendable abrasives are used; and, abrasive blasting enclosure movement and removal

Level 3 are tasks expected to exceed the air lead levels of 2500 $\mu g/m^3$. These are:

- abrasive blasting

- welding

- cutting

- torch burning

The HUD LBP Interim Guidelines and several other agencies have established worker protection guidelines for abatement work. In addition, the National Institute of Occupational Safety and Health (NIOSH) evaluated worker exposure to lead during the HUD Lead-Based Paint Abatement Demonstration. Data was collected during all phases of the abatement project; setup, abatement (abrasive removal, chemical removal, heat gun removal, encapsulation, enclosure, and replacement), precleaning, cleaning, and final cleaning.

Summary of Results

The heat gun method resulted in the highest personal exposure to lead. Most exposures measured during the heat gun method exceeded the OSHA PEL of 50 $\mu g/m^3$, except for exterior heat gun work, for which exposures were well below the PEL. Even though personal air samples for volatile organic compounds (VOCs) were well below the applicable exposure criteria for individual compounds, workers reported respiratory irritation associated with this type of exposure.

Personal exposures to airborne lead potentially exceeding the OSHA PEL were measured during eight of eleven NIOSH-assigned method categories: abrasive, chemical removal, cleaning, enclosure, heat gun, replacement, set up, and other. None of the exposures for encapsulation, final cleaning, and precleaning methods exceeded the PEL. Analysis of air sampling results indicated that personal exposures to airborne lead were generally low, but the variability of exposures was very high. Results suggested that the abatement method, housing abated, and the contractor were important determinants of airborne lead exposure. A summary of the results are presented in Table VII-1.

Pre- and post-abatement soil sampling indicated that lead paint abatement in some cases resulted in increases in soil lead levels one to three feet from exterior walls.

NIOSH recommended that the following actions be taken during lead abatement by HUD or private contractors.

1. LBP abatement methods currently associated with the highest personal airborne exposures to lead, such as heat gun and abrasive removal, should be avoided wherever possible.

2. Employers should provide facilities for worker personal hygiene to minimize exposure to lead through ingestion, and carry-home of lead contamination. Adequate washing facilities including running hot and cold water and wherever feasible, showers, should be provided at the worksite so that workers can remove lead particles from skin and hair. Contractors should arrange for collection and disposal of the wastewater in accordance with local and state requirements.

3. All workers exposed to lead should wash their hands and faces before eating, drinking, or smoking, and they should not eat, drink, or use tobacco products in the work area, or other potentially contaminated areas on site. Tobacco and food products should never be permitted in the work area. Contaminated work clothes should be removed before eating.

4. Workers should change into work clothes only at the work site. Street clothes should be stored separately from work clothes in a clean area provided by the employer so that they are not contaminated. Workers should change back into their street clothes after washing or showering and before leaving the worksite to prevent the accumulation of lead dust in the worker's cars and homes, and thereby protect family members from exposure to lead.

5. Appropriate disposable or washable work clothes should be provided by the employer. To reduce the potential for heat stress, breathable clothing should be used for all methods except for chemical removal, where chemical-resistant clothing is necessary. Worker shoes or disposable booties should have nonskid soles. Employers should arrange for the laundering of protective clothing; or, if disposable protective clothing is used, the employer should maintain an adequate supply at the worksite and arrange for its safe disposal according to applicable Federal and State

regulations. The launderer of lead-contaminated clothing should be advised (in writing) of the lead contamination and of the potentially harmful effects of lead.

6. Worker and supervisor training should emphasize method-specific health hazards, and proper work practices with the goal of reducing exposures and the significant variation between contractors. Also, training should provide additional emphasis on the prevention of safety and physical hazards such as slip, trip and fall, fire (due to heat guns and portable heaters), improper use of scaffolds and ladders, and electrical equipment hazards.

Table VII-1. Air Sampling for Lead by Method or Activity
HETA 90-070

Abatement Method/Activity	N Obs	Lead Concentrations ($\mu g/m^3$)			
		Minimum	Maximum	Geometric Mean	Geometric SD
Abrasive	28	0.4	399	8.8	7.6
Chemical Removal	291	0.4	476	3.3	4.1
Cleaning	138	0.4	588	1.9	3.6
Encapsulation	83	0.4	26	1.4	2.8
Enclosure	50	0.4	72	1.7	3.2
Final Cleaning	56	0.9	36	2.1	2.8
Heat Gun	360	0.4	916	6.4	4.7
Precleaning	31	0.9	11	1.5	2.2
Replacement	110	0.4	121	2.5	3.9
Set up	153	0.4	137	1.5	3.1
Other	15	0.4	207	1.9	5.1
Missing	87	—	—	—	—
Total	1402	0.4	916	3.1	4.4

These recommendations will help achieve one of the national health objectives specified by Healthy People 2000, which is to eliminate exposures that result in concentrations greater than 25 µg/dl of whole blood.

Section VI, In-place Management, contains personal protective equipment recommendations for workers performing in-place management and routine maintenance activities.

Occupant Protection Measures

If the surface of lead paint is to be broken as part of a lead abatement project, under most circumstances occupants and their belongings must be temporarily relocated.

Relocation of occupants and their belongings may not be necessary if all of the following conditions exist:

- Abatement work is of very limited scope
- Abatement work can be accomplished in one 8-hour working day
- The unit is still habitable in a practical sense (e.g., family has safe access to bathrooms and kitchen)
- The work area can be sealed

In the case of an abatement exclusively on the exterior of a building, residents and their belongings may not need to be relocated if the interior environment can be adequately sealed to assure that no lead dust enters the interior and safe entrance and egress can be assured.

Protection of Belongings and Furnishings

All moveable furniture, draperies and other belongings should be moved out of the work area (the rooms in which abatement will take place) before abatement begins. The base should be responsible for ensuring that belongings have been moved out of the work area before the contractor arrives to set up the containment system.

Wall-to-wall carpeting should be removed. However, if left in place, it should be covered with at least two sheets of 6-mil polyethylene sheeting and secured to the wall or baseboard with masking tape. Objects that cannot be moved should be covered so as to ensure that they are not contaminated by lead dust or other lead contaminated materials. Objects remaining in the work area should be wrapped or covered with 6-mil polyethylene sheeting and sealed with tape.

Removal and off-site storage can increase the costs of abatement and prolong the time of family dislocation. A more cost effective tactic is to use one room of the dwelling for storage of moveable furniture and belongings. If the work area would otherwise consist of the entire dwelling unit, it may be possible to conduct abatement in one room and then use that room for storage. For exterior abatements only, if it is possible to seal the interior environment adequately and provide safe entrance and egress, the base may not need to relocate residents and remove personal possessions.

Other Occupants of Multifamily Dwellings

Whenever units and or common areas within an occupied multifamily dwelling are being abated, the base must notify all residents within the building. The notice should consist of the following:

- Start-up date
- Areas to be abated
- A warning to heed caution signs

The warning sign should read as follows:
" CAUTION LEAD HAZARD - DO NOT ENTER WORK AREA UNLESS AUTHORIZED"

Cleanup Procedures

The goal of any lead-paint abatement project on high priority facilities is to provide an environment relatively free of lead contamination. Pilot abatement projects will help the base decide how much cleanup is required to meet clearance criteria.

The checklist in Appendix 10 should be consulted prior to a cleanup associated with lead-based paint abatement.

Cleanup Methods

Research and field studies have shown that there are two basic cleaning methods which, when used concurrently, have proven most effective in lead paint abatement projects. The dry cleaning method involves the use of a HEPA vacuum to clean all the surfaces of a dwelling unit at the conclusion of an LBP abatement project. The wet cleaning method involves the use of a high phosphate detergent to wash all the surfaces of a dwelling unit at the conclusion of a LBP abatement project.

HEPA Vacuum

HEPA vacuums differ from conventional vacuums in that they contain high efficiency filters which are designed to trap extremely small, micron-sized particles. These filters are capable of filtering out particles of 0.3 microns or greater from a body of air at 99.97% efficiency or greater.

As mentioned earlier, lead dust tends to break down into extremely fine, micron-sized particles. Vacuuming by conventional means is unacceptable in a lead paint abatement final cleanup because much of the fine lead dust will simply be exhausted back into the environment. Consequently, the use of a HEPA vacuum is required. Procedures for its proper use are discussed below.

There are a number of different manufacturers of HEPA vacuums. Although these HEPA vacuums operate on the same general principle, they may vary considerably in applicability. Operators should be sure that the machine they plan to use is the best suited for the purpose. It is important that operators carefully follow the operating instructions provided by the manufacturer of the machine they are using. If possible, training sessions should be arranged with the manufacturer's representative.

Since the HEPA vacuum will be used to vacuum surfaces other than just floors, it is important for operators to have appropriate attachments for use on unusual surfaces. Attachments such as various sized brushes, crevice tools, and angular tools should be procured along with the HEPA vacuum. Using these attachments properly will enhance the quality of the HEPA vacuuming process.

At the conclusion of the active abatement process, all surfaces potentially affected by the abatement process should be thoroughly and completely HEPA vacuumed. These surfaces include but are not limited to ceilings, walls, floors, windows (sash, sill, well), doors, fixtures of any kind (light, bathroom, kitchen), built-in cabinets, and appliances. These surfaces include abated surfaces and unabated surfaces exposed to lead dust generated by the abatement process. All rooms of the property should be included in this HEPA process except for rooms which were found free of lead paint and lead dust before the abatement process and were not affected during the process. Rooms should be vacuumed starting with the ceilings and working down to the floors.

HEPA vacuums must be properly maintained in accordance with manufacturer's instructions. Extreme caution should be taken any time the HEPA vacuum is opened for filter replacement or debris removal due to the high potential for accidental release of accumulated lead dust into the environment. Operators should wear a full set of protective clothing and equipment, including appropriate respirators, when performing this maintenance function. Used HEPA filters and vacuumed debris are potentially hazardous and should be treated accordingly.

<u>High Phosphate Wash</u>

Detergents with a high phosphate content (i.e., containing at least 5% trisodium phosphate, TSP) have been found to be most effective when used as part of the final cleanup process in a lead paint abatement project. The phosphate bonds with the lead in the dust to create a compound that is easier to remove from surfaces than is the product of washing with nonphosphate detergents. Because of concern for its impact on the environment, some states have regulated the use of high phosphate detergents. Consequently, some manufacturers have eliminated phosphates from their household detergents. The proper name for the chemical involved is trisodium phosphate, which is available in chain grocery stores and hardware stores.

Users of high phosphate detergents should carefully follow the specific manufacturer's instructions for the proper use of the product, especially the dilution ratio recommended. Even diluted, trisodium phosphate should be used only with waterproof gloves as it is very irritating to the skin.

At the conclusion of the active abatement process and after the first HEPA vacuuming, all surfaces should be thoroughly and completely washed with a high phosphate solution. These surfaces include but are not limited to ceilings, walls, floors, windows (sash, sill, well), doors, fixtures of any kind (light, bathroom, kitchen), built-in cabinets, and appliances. These surfaces include surfaces actually abated as well as those that were not, but were possibly exposed to lead dust generated by the abatement process. All rooms of the property should be included in this high phosphate wash process except for rooms that were found free of lead paint and lead dust before the abatement process began, were properly sealed, and were never entered during the process. Rooms should be washed by starting with the ceilings and working down to the floors.

Many manufacturers of high phosphate cleaners will indicate the surface area that their cleaning mixture will cover. To guard against the recontamination of the area by continued use of overly dirty

water, users should carefully follow the surface area limits provided by the manufacturer and change the cleaning mixture accordingly. In cases where the manufacturer does not indicate surface area limits, the cleaning mixture should be changed at least after each room has been washed. Care should be taken by the user each time the cleaning mixture is changed to ensure that the dirty water is not allowed to recontaminate the environment. This dirty water is potentially hazardous and should be treated accordingly.

Cleanup During Abatement

Daily cleanup helps minimize problems during final cleanup and limits the potential exposure of abatement workers to lead dust throughout the abatement process. A thorough cleanup of the entire area under active abatement should occur daily during the entire abatement process. This daily cleanup should consist of the following:

Large Debris

Large demolition-type debris containing lead-based paint (e.g., doors, window, trim) should be wrapped in 6-mil plastic, sealed with tape, and moved to the area designated for trash storage on the property. Since lead-contaminated debris is potentially hazardous waste, it should never be stored outside while awaiting removal/disposal. Consequently, an area inside the property or a secured dumpster must be designated as a temporary trash storage area.

Small Debris

Small debris should be swept up, collected, and disposed of properly. However, before any sweeping occurs, the affected surfaces should be sprayed with a fine mist of water, to keep surface dust from becoming airborne and potentially contaminating other areas of the property and abatement workers. Dry sweeping should be prohibited. The swept debris should be placed in double 4-mil or single 6-mil plastic bags, properly sealed, and moved to the designated trash storage area.

Exterior Cleanup

Unabated areas potentially affected by exterior abatements should be protected by using a containment system. Because weather can adversely affect the efficacy of exterior containment, the surface plastic of the containment system should be removed at the end of each workday. On a daily basis, as well as during final cleanup, the immediate area should be examined visually to ensure that no lead debris has escaped containment. Any such debris should be raked or swept and placed in single 6-mil or double 4-mil plastic bags, which should then be sealed and stored along with other contaminated debris.

Cleanup After Abatement

Before final cleanup can begin and before abated surfaces can be painted or sealed, the plastic sheeting used for containment must be removed. The contaminated plastic sheeting must be removed and disposed of very carefully. Removal should start with upper-level plastic, such as that on cabinets and counters. The plastic should first be sprayed or misted with water to hold down dust, and then folded upon itself to trap any dust or residues inside. Before removal of floor plastic, it should be sprayed and swept. It should be folded carefully from the corners/ends to the middle (to

trap any remaining lead dust) and placed into double 4-mil or single 6-mil plastic bags that are then sealed and removed from the premises. As with daily cleanups, this plastic removal process requires the use of protective equipment, especially appropriate respirators. Plastic sheets used to isolate contaminated rooms from noncontaminated rooms should not be removed at this time. These sheets should remain until after the preliminary final cleanup is complete and then be carefully removed as described above.

After the plastic has been removed from the contaminated area, the entire area should be HEPA-vacuumed; starting with the rooms farthest from the entrance to avoid retracing dust through the already-cleaned area. In each room, vacuuming should begin with the ceiling and proceed down the walls, making sure every surface is treated, including doors, door trim, windows, windowsills, wells, trim, baseboard, etc.

The entire affected area should next be washed down with a TSP solution and HEPA-vacuumed again using the steps already outlined. The contractor must not deviate from or skip any step. To do so could cause hazardous levels of lead dust and residue to be embedded in the new paint and mobilized later when that paint deteriorates or is abraded.

Painting or otherwise sealing abated surfaces and all interior floors is the next step of the cleaning process. Sealed surfaces are much easier to clean and maintain over time than those that are not sealed. Also, this sealing process may encapsulate any remaining lead dust particles that were not removed by the HEPA-phosphate wash-HEPA treatment. However, painting or coating should never be used as a substitute for thorough cleaning.

Final Cleanup

After painting/sealing is complete, the final cleanup can take place. The recommended method for the entire affected area is as follows:

- First, it should be HEPA-vacuumed again.
- Second, it should be washed down with TSP solution again.
- Finally, it should be HEPA-vacuumed again.

Wall and ceiling surfaces painted with latex paint may be exempted from the final wash due to the danger of staining or otherwise damaging the final painted surface, but should be HEPA-vacuumed again. Also, it may be possible to use less rigorous final cleanup steps, as long as clearance requirements are still met. The degree of final cleaning necessary can be determined by clearance testing during the pilot abatement project.

After the final cleanup is complete, the final inspection should take place. As with the preliminary visual inspection, the final inspection has two primary goals. The first is to ensure that the abatement work is complete. The second is to ensure lead-contaminated surface dust is not a problem. As stated previously, the abatement process often releases large amounts of lead, even when methods that do not release much visible dust are used. Abatement without proper cleanup can yield lead dust levels of several thousand micrograms per square foot or higher. To meet the two goals of the final inspection, the inspector must perform both a visual inspection and clearance testing of lead levels in surface dust.

Postabatement Visual Inspection

First, the inspector should confirm job completeness by determining whether all surfaces have been abated according to the approved abatement plan. Special attention should be given to areas where lead paint has been removed adjacent to paint that is intact (for example, where paint has been removed from a door frame but nonlead paint is left on the baseboard). Paint at this joint should be sound. Windows should be checked for paint in hard-to-reach places. The inspector must make sure that all surfaces and all floors have been repainted or otherwise sealed.

Next, the inspector should determine whether the dwelling has been adequately cleaned by examining all surfaces for dust and debris. A damp cloth should be used to collect dust from surfaces such as floors or windowsills. This is the practical method for establishing that no dust is left, and should not be confused with dust monitoring. If dust is found, the work area should be recleaned and the damp cloth test repeated.

Cleanup Criteria

There are no Federal standards governing the level of lead dust at the present time. The states of Maryland and Massachusetts and the Department of Housing and Urban Development (HUD) have established the following standards for specific interior surfaces:

Floors: 200 micrograms per square foot
Windowsills: 500 micrograms per square foot
Window Wells: 800 micrograms per square foot

Since there are no applicable Federal standards, it is recommended that these levels be used as clearance criteria for high priority facilities until such time as they can be refined or replaced through additional research. Before a unit is reoccupied after abatement, it should be demonstrated that residual lead dust levels are in compliance with the criteria.

The decision rules that should be used for the determination of compliance with the clearance criteria are as follows:

- In each area within an individual unit, compare the residual lead dust level from each wipe sample (as derived from the laboratory results) with the clearance criteria. If any of the residual lead dust level results exceed the clearance criteria, the area must be cleaned again and retested until the criteria are met.

- If all residual lead levels for an area meet the clearance criteria, the area is cleared for reoccupancy.

- A unit may be cleared for reoccupancy only after all areas within that unit have been cleared according to the criteria above.

In the case of exterior abatement, the standard for floors should be applied to porches. For limited abatement, it is important to ensure that areas outside the containment area were not contaminated during the abatement work. Therefore, soil and/or dust samples should be taken in such areas before and after abatement and the lead levels compared to check whether an

increase attributable to the abatement has occurred. If it has, final cleanup and clearance testing must be extended to the affected areas.

Qualified Contractors

Abatement contractors must have wide experience in building renovation and restoration procedures and be aware of all applicable Federal, State, and local regulations pertaining to lead abatement work and any relevant licensing or certification requirements.

All abatement workers must be trained in LBP abatement and have a preabatement medical examination. In addition to skills specific to lead abatement, abatement workers need basic construction skills to perform various abatement jobs, such as: demolition, carpentry, painting, and floor installation. The types of general construction skills needed will depend on the base's choice of abatement and modernization strategies and methods.

In April 1994, EPA plans to present notice of proposed rulemaking (NOPR) on a Model State Plan, composed of two components: (1) Model Accreditation Plan and (2) EPA Training and Certification Program for LBP Activities.

An advance copy of the NOPR indicates the following will be included:

- The procedures States must follow when seeking authorization from EPA to administer and enforce a state program.

- The process training programs must follow to become accredited and the provisions for the certification of individuals and firms engaged in LBP activities.

- The standards for conducting LBP activities in "target housing," public buildings (constructed before 1978), commercial buildings, and superstructures.

The final rule is expected by April 1994. States will be required to implement the Model State Plan by April 1996 or EPA will administer the program.

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SECTION VIII

WASTE DISPOSAL REQUIREMENTS

Introduction

Environmental regulations, as promulgated by the Resource Conservation and Recovery Act (RCRA), currently require the characterization of lead containing wastes to determine proper disposal criteria. The base has the responsibility to ensure that all lead-based paint (LBP) abatement wastes are disposed of properly. The Bioenvironmental Engineer plays a significant role in determining the fate of such waste. This section provides guidance to installation Bioenvironmental Engineering Services (BES) on legislative requirements, waste stream characterization, Toxicity Characteristic Leaching Procedure (TCLP) background, sampling procedures, and waste disposal preparation.

Regulatory Requirements

Resource Conservation and Recovery Act

In 1976 Congress passed RCRA which was designed to track and regulate hazardous wastes from the time they were manufactured to final disposal. The U.S. Environmental Protection Agency (EPA) continuously develops RCRA regulations and publishes them annually in the Code of Federal Regulations (CFR). RCRA distinguishes between solid waste and hazardous waste. Solid waste is a very broad term covering all solid and liquid forms, and some gaseous forms, of household trash, discarded industrial materials, sludge from waste treatment plants, and so forth. Hazardous waste is solid waste that may substantially pose a threat to human health or the environment when improperly handled.

Hazardous wastes are regulated differently than nonhazardous wastes. Solid wastes (non-hazardous) are regulated under Subtitle D of RCRA, and are subject to minimum technical standards for landfills. Subtitle C of RCRA, on the other hand, regulates hazardous waste through a "cradle-to-grave" system to ensure proper management from generation through ultimate disposal. RCRA sets forth requirements to assure that the disposal of hazardous waste is effective and permanent to the extent of no escape of hazardous materials to the environment.

LBP abatement projects produce potentially large quantities of solid waste which may be hazardous waste. Such wastes must be considered under Subtitle C of RCRA because of possible lead content. Lead is considered to be a threat to human health and the environment if uncontrolled, treated, or disposed of improperly. Disposal restrictions are solely based on the possibility that the lead content in such wastes may leach if placed in a sanitary landfill. Specific laboratory tests required under RCRA are designed to measure this potential. **At the present time (Oct 93) Federal EPA has no special exclusions or provisions governing the disposal of debris coated with LBP. See the section on State and Local Laws and Regulations for additional information.**

State and Local Laws and Regulations

States regulate solid (nonhazardous) waste, and many run their own hazardous waste programs with U.S. EPA approval under RCRA. RCRA encourages states to assume some of the Federal responsibilities for operating their own Regional EPA approved hazardous waste management programs. In general, state laws and standards are required to be equivalent to or more stringent than Federal hazardous waste standards. There are some variations from state to state, and certain states

have enacted very stringent hazardous waste and air quality requirements. For instance, EPA Region I currently plays the lead role in research and development of LBP waste management. States in this region have more detailed standards and consequently more guidance in implementing these standards than other states. At the local level, it is imperative that the BES, as well as other key players on the installation (i.e., Environmental Management/Flight), coordinate their hazardous waste activities (especially sampling and disposal requirements) regarding LBP waste with the appropriate state, county, and local agencies before disposal/demolition actions are undertaken.

Potential Regulatory Changes and Upcoming Guidance

Public Law 102-550, Title X, Residential Lead-Based Paint Hazard Reduction Act of 1992, consists of the Amendments to the Toxic Substance Control Act (TSCA). A bill was signed on 29 October 1992 initiating "Title X". It will effect training and accreditation of LBP activities including abatement, demolition, and hazardous waste sampling determination of wastes. Codifying Title X into 40 CFR is currently under development and should be finalized by April 1994. No further details are currently available, but this legislation will impact BES activities in the near future.

The Draft Air Force Pamphlet (AFP) 19-XX, "Air Force Hazardous Waste Management Guide," is soon to be final *(AFP 32-7042)*. It provides specific guidance for implementing the Air Force Hazardous Waste Management Policy, AF/CV Ltr 6 June 1991 and AFI 32-7042, Solid and Hazardous Waste Compliance. Roles and responsibilities of the BES, as well as other key players, are clearly defined in this guidance.

All segments of the Federal government affected by regulations concerned with the disposal of LBP abatement wastes are presently working to develop guidance pertinent to their areas. This includes the Department of Transportation (DOT), Department of Housing and Urban Development (HUD), EPA, and all services of the Department of Defense (DoD). For instance, the U.S. Army Environmental Hygiene Agency (USAEHA) recently published an interim-final document that includes guidance on LBP hazardous waste prediction and management. (Citation is in reference section.) The EPA is concurrently developing similar guidance that should be final by *April 1994*. The EPA is considering how the military services are handling LBP activities along with various state regulations to develop the "best" approach to LBP waste disposal management. The EPA is also looking at recycling possibilities for some types of LBP abatement waste, such as wood components. As information becomes available, it will be considered by the Air Force and implemented as it applies.

Anticipated Waste Streams

The LBP abatement actions described in the previous chapter will produce specific waste types. In general, any activity that concentrates LBP has the potential to create a hazardous waste. Typically, the polyethylene used in abatement and personal protective suits will be nonhazardous waste as long as they are decontaminated with a high efficiency particulate air (HEPA) filtered vacuum. Removed substrate components that contain LBP can be either hazardous or nonhazardous waste. This section will discuss various abatement activities and the anticipated quantity and type of waste associated with each activity. BES must identify the wastestreams resulting from the abatement activities and include them in the installation's Waste Analysis Plan. Though these general guidelines state that certain decontaminating procedures will render some wastes nonhazardous, remember that BES must comply with local regulations on the need for TCLP testing.

Cleanup

This type of activity is typically associated with a building that contains high dust lead levels or final cleanup actions that occur at the end of an abatement project. It essentially includes a HEPA vacuuming of all surfaces, a wipe down of all surfaces with a 5% - 10% solution of trisodium phosphate, and finally a second round of HEPA vacuuming of all surfaces. Waste materials generated by this activity include HEPA vacuum contents, rags, mops, sponges, water, personal protective equipment, and polyethylene. Generally, HEPA vacuum contents will test as hazardous waste. Waste water should be filtered through a 5 micron filter and the filter should be disposed of as hazardous waste. State and local regulations will determine the disposal criteria of filtered water as high concentrations of phosphates and pH may be found in this water.

Paint Removal

All lead-based paint removed from a substrate by virtually any method will, almost without exception, be hazardous waste and should be disposed of accordingly. Polyethylene and personal protective suits will need to be considered for disposal too. Generally, HEPA vacuuming both suits and polyethylene will render these materials as nonhazardous. Specific factors must be considered for waste disposal when using different paint removal methods for abatements.

In addition to the methods discussed, there are and will be other methods of LBP abatement developed as this industry matures. Many of these will involve paint removal from substrates and will undoubtedly be some type of mechanical removal process. The medium used, if any, to remove the paint from the substrate, should be considered in the waste disposal process as well as the lead-based paint itself.

Chemical Strippers

The use of chemical strippers will increase the volume of hazardous waste. Most of the strippers are very caustic (pH 13), and upon use generally become a pH of 9-10. This pH may be below the hazardous threshold but, many municipalities will not allow disposal, particularly of water in this pH range. Chemicals also require neutralization of the abated substrate. This generally increases the volume of liquid to be managed. Any water should be filtered, as previously discussed. In addition, chemically contaminated polyethylene and protective clothing should be kept separate from other plastic and clothing to avoid increasing potential hazardous waste.

Several product manufacturers of chemical strippers are researching methods and materials that will render the removed paint and stripper nonhazardous. If such products are used at the installation, BES should ensure that the validity of any such product claim is correct and that the materials can be disposed as nonhazardous waste. The product Material Safety Data Sheet (MSDS) is a good starting point for this determination.

Abrasion

Depending on the mechanical method employed, removed paint chips generally include some spent medium, such as steel shot or walnut hulls. Exceptions to this are the needlegun, which results in paint chips and dust only, and sanding-grinding operations which result in dust (and used abrasive pads). These systems should have a HEPA collection system to capture the paint dust and chips.

This collected material will almost always be hazardous waste. Polyethylene and protective suits worn during the abatement work should be HEPA vacuumed to render them nonhazardous.

Heat Gun

The use of heat guns for LBP abatement results in a concentrated mass of paint chips. These chips are generally put into containers by hand, or are HEPA vacuumed from the polyethylene. These will generally be hazardous waste.

Removal of Components

The removal of components containing or contaminated with LBP vastly increases the volume of waste material. Wastes from this type of abatement are typically windows and windowsills, doors and door frames, shelves, baseboard, and other trim. Though the amount of waste increases with this type of abatement, the adherence of the LBP to a substrate may decrease the amount of leachable lead in the waste. As a result, the chance of component waste failing the TCLP test may be lower than that of paint removal waste. The EPA is considering this in developing its LBP guidance. Cleanup is also required in this type of abatement, so cleanup materials must be considered for disposal.

Encapsulation and Enclosure

LBP abatement by encapsulation or enclosure should result in very little hazardous waste. Since these methods require a clean, intact surface, paint chips associated with wet scraping and the contents of HEPA vacuums are typical hazardous wastes. There will be wash water waste generated with these methods. Polyethylene and protective suits will be utilized as a result of this type of abatement; however, HEPA vacuuming of these items should ensure that they are nonhazardous waste.

Waste Characterization

This section describes procedures and methods used to provide characterization of the solid waste generated during demolition, Operations and Maintenance (O&M) tasks, and LBP abatement activities.

As described in other Air Force Instructions and guidance documents (AFI 32-7042, Solid and Hazardous Waste Compliance) BES provides installation technical expertise on Hazardous Waste Identification and is the OPR for developing the installation Waste Analysis Plan (WAP). Waste generated from projects involving LBP must be included in the Installation WAP and should be managed appropriately.

The US Army Environmental Hygiene Agency (USAEHA) has conducted extensive testing of debris generated from the demolition of World War II era structures and other waste items such as those resulting from abatement and renovation activities. When whole-building characterization has been employed, as discussed in the following sections, it was found that the wastes can be classified as nonhazardous. Wastes were classified as Hazardous Waste (HW) when LBP was consolidated and concentrated (i.e., abatement waste - chemical stripping). Whatever classification scheme was employed, it was stressed that coordination with local and State environmental authorities was of the utmost importance.

LBP Abatement Activities

See the preceding section and the previous chapter on the anticipated wastes generated from abatement activities. As stated earlier, LBP removed from a surface (by any method) will generally be classified as hazardous waste, sampling is usually not required.

Demolition Projects

Overview

Before characterizing the waste, it is necessary to define the wastestream. This report defines the wastestream or "population" that is being characterized as the debris generated during a given demolition project at a given site. Similar buildings scheduled for demolition (consider: age, use, construction materials) may be grouped to form a population. Only a percentage of the population would be required to be sampled. Use Table V-3 in Section V of this report for determining the number of buildings to sample from the population of buildings to be demolished. Typically, a Civil Engineering project would constitute the sample population.

Sample

The goal is to collect a "homogenous sample" whenever characterizing hazardous waste. Demolition waste containing LBP is no different. The sample should be representative of the entire building to be demolished. A representative proportion of the entire structure should be included in the sample to include glass, wood, cement, brick, and roofing materials. It is important to identify what portions of the buildings are to be recycled or disposed of separately from the general building debris. For instance, asbestos (transite) siding on some structures may be removed and disposed of separately. Metal ductwork, furnaces, piping, light ballasts, and metal siding may be removed and reused/recycled as scrap metal. The components to be recycled or disposed of separately should not be included in the LBP composite homogenous sample.

Sample Collection

a. For the typical LBP sample going to Armstrong Lab for TCLP, 250 grams (6-8 ounces) of the solid material needs to be collected in a wide-mouth colorless sturdy glass container (Qorpak or equivalent). On the AF Form 2751, Bulk, Material Sampling Data Sample Collection Data, Block B, Indicate "TCLP-Lead (PB) Only."

b. The following tactic should be used to collect the representative sample from an intact building. The proportional size of the various building areas based on (estimated) square footage must be determined. For instance a building may be 70 feet long, 40 feet wide, and 12 feet high; if all four of the exterior walls are made of the same material, there should be 2,640 ft^2 of the material/component. Window and door space should be subtracted out of the exterior-interior walls and considered as separate areas. The total estimated areas (i.e., exterior wall, interior plaster wall, interior plywood/paneling wall, floor, cinder block supports, etc.) should be compared to one another in order to establish ratios. The ratios will determine the number of samples to obtain from each individual area. Generally 60-70 subsamples are necessary to make-up one 250 gram sample (number will vary depending on building material).

c. Using a 1 - inch bit drill or similar device, a "core" subsample should be obtained from the selected areas of the building. (Use caution when drilling into unknown areas containing live wiring or plumbing). The subsample material should be collected into a disposable container (such as large sheets of paper) as the drilling is done. The sampling crew should, to the extent possible, drill through the entire substrate. For building components such as cinder block or cement an air powered hammer drill or similar device should be used. The number of drill holes obtained from each type of surface/area should be recorded. If the number of overall subsamples is not enough (less than 250 grams collected) for the TCLP, additional subsamples should be obtained from each of the specific areas until the sample minimum is obtained. [Note: For at least 5 percent of the samples (and a minimum of one sample), approximately 500 grams should be obtained for an adequate split laboratory analysis.]

d. Field duplicates, equaling 5 percent of the number of actual samples (at a minimum of one) should be obtained to check the sampling practice. The duplicate(s) should be obtained by simultaneously filling two sample containers during the sample process (i.e., for each subsample within a sample building, two adjacent cores should be obtained and placed into two separate containers).

e. Collection and Labeling. The sample material from the building should be collected onto a (disposable) container (such as sheets of unused paper, paper plate, etc.). From this collection container, the materials should be emptied into the clean wide mouth glass container for shipment to Armstrong Lab or other equivalent lab for analysis. The wide mouth glass container should be labeled with the project/installation name and or identification number, sample number, building number, sample date and sample personnel's name.

f. Decontamination. Nondedicated sampling equipment such as the drill bit should be decontaminated between sampling of individual buildings. The sampling crew should first brush excess materials from the equipment and then wash using tap water and soap. This should be followed by a final rinse with distilled, deionized, filtered (DDIF) water. To ensure the equipment was properly decontaminated, a used rinse water sample should be taken and analyzed.

g. Personnel Safety and Industrial Hygiene. See Appendix 11 for a sample Site Safety and Health Plan (SSHP) and related recommendations to use when bulk sampling LBP wastes.

<u>Timing</u>

One logical consideration that should be addressed before demolition occurs is <u>when</u> do we want to sample, before the building is torn down or after it becomes a pile of waste rubble. For safety purposes, it is recommended whenever possible to sample the building before it is torn down, as sampling rubble piles and climbing onto dump trucks filled with debris is not without risk. If sampling <u>is</u> required of a rubble pile, refer to AFP 32-7042, AF Hazardous Waste Management Program, Chapter 15, and EPA Report EPA-60012-80-018, "Sampling and Samplers Procedures for Hazardous Waste Streams" (available from USAFSAM/BE) for more information on hazardous waste sampling of waste piles. Preplanning is critical, as the time to consider sampling is not after a building is ripped down and is waiting for disposal; Civil Engineering (CE) and Environmental Management (EM) will want to know the answer of what to do with the waste before the wrecking ball and front-end loader arrive on site.

Operations and Maintenance (O & M) Tasks

Overview

The waste generated from O&M work in CE can generally be put into two categories; component replacement and repair. Usually, wastes generated from repair activities (i.e., replacement of window glass in a window frame coated with LBP) does not require sampling. The wastes generated from component replacement (i.e., doors, windows, garage doors, etc.) coated with LBP may require sampling. Coordination with local and county regulators concerning disposal of these items in a construction or municipal landfill is crucial. As stated earlier in this section, the relationship of TCLP sampling versus cost of waste disposal must be established. For small jobs generating LBP waste, the approximate quantity and type of material (i.e., wood window frame or door) that will make up the waste debris must be estimated. The cost of disposing of this waste as hazardous waste (HW) should then be established. In most cases EM, HW disposal contractor, or DRMO can provide the cost estimate based on pounds and volume of waste destined for disposal. The cost of disposing of the waste as HW should then be compared to the analytical costs for performing the TCLP for lead. Generally, it may be cheaper to dispose of one or two doors or a 5 - gallon can of paint chips as HW rather than taking a sample for analysis. Local circumstances govern this procedure, and the guidance in this report should not be construed to be Air Force Policy on this topic. Larger scale renovation projects may fall into the O & M arena and may involve generating larger volumes of waste (usually a dumpster or truck load of waste); in this case it may be beneficial to obtain samples and characterize the waste. The number of samples to obtain will depend on the types and amounts of materials being tested. The sampling protocol stated previously in the demolition section (drill bit method) should be used to characterize waste in this category when local authorities require sampling.

User Knowledge

If sampling/characterization of LBP waste is required by local environmental authorities, the concept of user knowledge may alleviate the need for sampling. The larger the proportion of lead-paint to the overall wastestream, the greater the likelihood that the waste will be hazardous. Generator knowledge can often help in the decision to sample or not to sample. Knowledge obtained from previous sampling activities, as-built drawings and specs, XRF readings (Note: there is no correlation between XRF value and percent leachable lead in the TCLP test), MSDSs, or other manufacturer information may be used in lieu of actual analytical sampling when requested. Whenever characterizing waste based on user knowledge, insure the sources used to base the decision are readily available on file for review by regulators as needed.

Toxicity Characteristic Leaching Procedure (TCLP)

The TCLP test is used to determine if lead contaminated material is classified as being hazardous waste. Specific TCLP laboratory analysis procedures are outlined in Appendix II to EPA regulation 40 CFR Part 261, "Identification and Listing of Hazardous Waste." The TCLP test can be directed to analyze for all eight heavy metals and organic and inorganic compounds. Primarily, lead contaminated waste is considered to be hazardous waste if TCLP laboratory analysis results indicate a concentration of lead equal to or greater than 5.0 milligrams per liter (parts per million). Materials used in LBP abatement may also become hazardous waste due to ignitable or corrosive characteristics. Compounds and threshold limits for hazardous materials and waste are outlined in 40 CFR Part 261.

In general, the TCLP test (EPA Method 1311) requires cutting the representative waste samples into pieces small enough to fit through a 9.5 mm (0.375 inch) sieve, placing those pieces in an acetic acid solution, and tumbling the slurry for 18 hours. A sample of the liquid is then tested for its lead content. If the waste tested has a lead concentration equal to or greater than 5.0 parts per million (ppm), then the waste is considered hazardous.

Sample particle size may vary in the TCLP test. LBP abatement samples that have been sent in for TCLP testing have been in the form of cross-sections of material (paint and substrate). Particle size reduction is conducted so that the sample will fit through the RCRA required 9.5 mm sieve. The TCLP results from such samples would be more conservative: a smaller particle exposes a greater surface area of the sample so that more lead can leach out. 40 CFR Part 261 allows for this variation in the TCLP samples.

When to Use the TCLP Test

The major decision factor for performing TCLP testing is cost. Depending on the material tested, multiple TCLP tests may be required. Typical TCLP costs range from $100 to $300, depending on the laboratory and the extent of the test analysis. Multiple testing on a single sample can cost up to $1000. According to RCRA, it is permissible to assume a waste material is hazardous and dispose of it accordingly (user knowledge). If local laws permit, it might be prudent to dispose of small amounts of suspect hazardous waste as hazardous rather than paying for TCLP testing. Without test data or verifiable generator knowledge, a waste material suspected of containing or of being contaminated with LBP should not be disposed of as a nonhazardous waste.

If any type of waste fails the TCLP, all of the waste considered to be part of the wastestream tested must be disposed of as hazardous waste. There is not enough space or money to dispose of all the waste from the proposed Air Force LBP abatement projects as hazardous waste. Installations must apply the best demonstrated available technology (BDAT) to determine the composition of samples so that they represent the true conditions of how a waste will "act" in a landfill. As previously stated, the EPA and other groups are researching the disposal of LBP-containing waste to determine if and when a hazardous waste condition exists. All base personnel involved with waste disposal should be aware of current directives for this issue.

Synthetic Precipitation Leaching Procedure (SPLP)

EPA is testing the SPLP which uses inorganic acid instead of organic acid in the leaching process. The inorganic acid is similar to acid rain. EPA is analyzing studies that compare the results of SPLP and TCLP as they apply to LBP waste. The application of this test is not yet clearly defined.

X-Ray Fluorescence (XRF)

At present, there is no correlation between known lead concentrations on components by XRF testing and failure of the wastestream by TCLP testing. Testing of painted surfaces in building components by XRF methods may determine that LBP exist above abatement thresholds (generally 1.0 milligram per square centimeter or 5000 ppm). Studies have shown, however, that this is not an indication that the wastestream will fail the TCLP test required to determine if the waste is hazardous or nonhazardous. XRF theoretically measures the total amount of lead in a specified area. TCLP measures leachable lead, which could possibly be the total lead content, but this is not likely. The

amount of leachable lead depends on the layer of LBP within a sample, the substrate it is painted on, and the physical characteristics of the sample itself. The total lead content does not consider these qualitative properties.

For example, the Consumer Product Safety Act defines lead free paint as paint containing less than 0.06% (600 ppm) total lead. This is far below the abatement threshold as determined by XRF. A solid sample painted with this lead free paint has the potential to leach almost 600 ppm of lead, if the total lead content is leached. This is way above the hazardous waste determination threshold. Assuming that all of the lead from material such as window trim is leachable is not realistic, though. Leachable lead, as determined by the TCLP test, may be well below the regulatory threshold of 5 ppm. Presently, this can only be determined by conducting the TCLP test for the specific sample substrate.

Sampling Requirements

The Bioenvironmental Engineer must evaluate the waste produced by abatement to determine which types are hazardous. RCRA states that the determination can be based on prior generator knowledge of the particular waste. Unfortunately, many states require TCLP testing for all wastes related to LBP abatement. In addition, even if the state does not require testing, a specific landfill may not allow the disposal of certain wastes without testing based on their own risk analysis. BES must work with the installation's Environmental Management or Environmental Engineering and disposal contractor (usually the Defense Reutilization and Marketing Office (DRMO)) to determine unique sampling requirements for disposal.

Sampling Procedures

The EPA's Solid Waste Test Methods for Evaluating Solid Waste (SW-846), Volume 3, Chapter 9, outlines general sampling plan strategies that can be applied to LBP abatement projects. EPA LBP management guidance will augment SW-846 by detailing specific requirements for LBP wastes, including the magnitude of sampling required. General hazardous waste sampling information may be found in SW-846 and 40 CFR 261 Appendix I. For general questions concerning the adequacy of a sample, contact AL/OEA at DSN 240-3626. "Samplers and Sampling Procedures for Hazardous Waste Streams," EPA 600/2-80-018, January 1980, is another useful reference.

Personal Protective Equipment (PPE)

The nature of this work requires that sampling procedures be clearly identified and followed in accordance with established hazardous waste sampling protocols. Sampling should only be conducted as a team. The use of half-face respirators approved for protection against lead containing dusts, mists, or fumes should be required until personnel air monitoring proves otherwise. Protective tyvek suits are advisable if they can be reused; however, work clothes are sufficient, providing personnel change into "home" clothes at the end of the shift. Also, personnel should be proficient with the tools and wear eye, face, hands, feet, and hearing protection.

Sampling Equipment

Equipment for hazardous waste determination sampling varies, depending on wastes to be sampled. Tools to sample components painted with LBP may include a circular or reciprocating saw,

hammer, chisel, wrecking bar, and a metal cutting tool. In general, tools should be selected based on the materials to be sampled and the ease of which the tool can be decontaminated. Other wastes will require typical hazardous waste sampling tools as described in the *Draft AFP 32-7042.*

Decontamination

In general, tools should be decontaminated by first brushing off all loose debris and wet wiping (single stroke/surface) all surfaces of the tool with alcohol swipes. At a minimum, personnel should clean their hands and faces after cleaning their tools. The brusher/wipes should be considered contaminated and disposed of accordingly when worn beyond practical use. All PPE must be properly decontaminated and/or disposed of IAW standard procedures discussed in previous sections. Work clothes must remain at the workplace and be laundered separately.

Sample Size and Containers

A sample taken for TCLP analysis requires different amounts and container types depending on the physical phase of the sample. Table VIII-1 outlines these criteria according to SW-846 and Armstrong Laboratory, but always confirm the information with the laboratory that will perform the analysis. Solid samples should be large enough for laboratory personnel to safely cut it to pass through the sieve. Aqueous wastewater samples must be acidified to a pH of <2 with HNO_3. Nonaqueous samples shall be refrigerated when possible. All sample containers must be prewashed with detergents, acids, and Type II water (ASTM D1193).

Table VIII-1. TCLP RCRA Sample Requirements

A. Full TCLP

Phase	Sample Size	Container
Liquid	2000 ml 2, 40 ml vials	2, 1 liter glass 2, VOC vials
Solid	250 grams 2, 40 ml vials	wide mouth glass 2, VOC vials

B. TCLP Metals*

Phase	Sample Size	Container
Liquid	1000 ml	1, 1 liter glass
Solid	250 grams	wide mouth glass

*Appropriate for most LBP abatement wastes

C. TCLP Metal (Lead Only)

Phase	Sample Size	Container
Solid	250 grams	1, wide mouth glass

Choosing a Laboratory

If a base utilizes a laboratory other than Armstrong Laboratory's Analytical Division, BES should make sure that the laboratory currently used for TCLP analyses is participating in accreditation programs specific to lead and hazardous waste analysis. The laboratory should be accredited by the American Association of Laboratory Accreditation for TCLP and lead analysis. When sending any type of samples to a laboratory, it is helpful to discuss factors such as size of sample to extract, packaging of samples, and desired turnaround time with the laboratory.

Quality Assurance/Quality Control (QA/QC)

QA/QC should be performed throughout this process as described in SW-846. The sampling field team should ensure all samples are properly labeled and that tools and personnel are properly decontaminated between samples.

The laboratory that was selected to perform the analysis should be proficient in such analysis and have a documented QA/QC program. The personnel submitting the samples to the laboratory should clearly state that the samples are to be cut into pieces capable of passing through a 9.5 mm sieve. It is advisable to contact laboratory personnel to ensure that they understand the procedure and that they have the equipment to properly cut the samples and run the analysis.

To attain quality control, blanks should be processed for each analytical batch of samples processed to aid in determining if samples are being contaminated. Duplicate samples should also be processed routinely. A duplicate sample is a sample brought through the whole sample preparation and analytical process. They are used to determine precision. SW-846 recommends duplicating 20% of sample load. Spiked samples or standard reference materials should be employed to determine accuracy. A spiked sample should be included with each group of samples processed.

Waste Disposal

If the waste is determined to be hazardous waste, BES must notify the EM function or DRMO. They will then package, label, store, and initiate transport of the waste to a Temporary Storage Facility (TSD) as outlined in Draft AFP *32-7042*.

Waste Awaiting Identification

Until sampling results are available, storing the waste can cause problems for the installation. A base may store the waste within the installation 90-day accumulation site and label it as "awaiting test results." State authorities and the EPA can then enforce the 90-day limit with the stored waste. In the past, their reasoning has been that once the installation began treating the waste as hazardous (by placing it in an accumulation site), the waste must comply with RCRA. If test results do not come back within the 90-day storage limit, it can be construed as noncompliance.

BES should work with the EM shop (or its equivalent) to minimize problems. Installations may want to utilize state authorities or EPA hotlines to address areas of question, before they become the focus of an inspection. The EPA RCRA hotline is 1-800-424-9346. Installations may also call Armstrong Laboratory's Hazardous Waste Function of the Bioenvironmental Engineering Division (OEB) for guidance on such issues at DSN 240-3305. This would circumvent direct confrontation

with EPA. Communication among all parties involved is imperative to proper hazardous waste management.

References

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Title 40 Code of Federal Regulations Part 240 through 280, Implementing the Resource Conservation and Recovery Act

APPENDIX 1

APPENDIX 1

Capillary Sampling Protocol

Microspecimens of blood collected by fingerstick are widely used to measure lead levels, yet there is no consensus on what constitutes the best collection procedure. Published data on collection methods are scant, and much of the data that do exist were published 10 or more years ago, when technology was not as advanced and blood lead levels of concern were significantly higher.

The high potential for lead contamination of capillary specimens during collection is well known , and the special steps used to minimize the likelihood of contamination constitute the major differences among collection procedures. Special procedures used for minimizing contamination include thorough scrubbing of the hand and finger with soap and then alcohol; using dilute nitric acid; or using silicone or a similar barrier spray .

Several types of containers for collecting children's blood (maximum volume $\leq$ 500 μL) have been introduced in recent years and are widely used by screening programs. The new containers are better than glass tubes, since glass capillary tubes are very fragile. Whether these new containers are suitable for collecting blood for lead measurement has not been extensively studied.

More research on these and other issues is clearly needed before the best fingerstick collection procedures can be identified. Recognizing these constraints, a fingerstick procedure for collecting blood lead specimens follows.

A. NEEDED MATERIALS

1. Soap.
2. Alcohol swabs. If a surgical or other disinfectant soap is used, alcohol swabs can be eliminated.
3. Sterile cotton balls or gauze pads.
4. Silicone spray or swabs. The benefits of using a barrier spray, which forms a layer between the skin and blood droplets, have been debated. In addition to doubts about the spray's effectiveness in reducing specimen contamination, the spray makes the collection more expensive and complex. Some evidence exists, however, the spray reduces contamination , so it is included in this procedure.
5. Examination gloves.
6. Lancets. The type of lancet used is largely a matter of personal preference, so long as sterility is guaranteed.
7. Collection containers. If glass capillary tubes are used, sealing clay or tube caps will also be required. No additional supplies are needed for most other microcontainers. The laboratory should be consulted to ensure that an appropriate size capillary tube is used.
8. Adhesive bandages.
9. Trash bags suitable for medical waste and containers for sharps. Bags containing medical waste should be clearly identified as such.
10. Storage or mailing containers if needed. If specimens require shipment, follow the Postal Service or other appropriate regulations for shipping body fluids. Materials used in the collection procedure that could contaminate the specimen (for example, blood containers, alcohol swabs, and barrier sprays) must be lead-free. Before selecting equipment for use in blood collection, consult with the

laboratory about its requirements. In many cases, the laboratory will recommend or supply suitable collection equipment and may precheck the equipment for lead contamination. Some instrument manufacturers also supply collection materials that are pretested for lead content.

B. PREPARING FOR BLOOD COLLECTION

All personnel who collect specimens should be well-trained in and thoroughly familiar with the collection procedure. The skill of the collector will greatly influence the specimen quality. All equipment should be within easy reach. The environment should be clean, secure, and as nonthreatening to the child as possible. Any necessary consent should be obtained before specimen collection begins, and the procedure should be explained to the child and the parent or guardian. Used materials should be discarded into appropriate waste containers suitable for medical waste immediately following use.

C. PREPARING THE FINGER FOR PUNCTURE

NOTE: Puncturing of the fingers of infants less than 1 year of age is not recommended. Puncturing of the heel is more suitable for these children.

Collection personnel should wear examination gloves whenever the potential for contact with blood exists. If the gloves are coated with powder, it should be rinsed off with tap water. The child's hands should be thoroughly washed with soap and then dried with a clean, low lint towel. If water is unavailable, foam soaps can be used without water. Plain, unprinted, nonrecycled towels are best. If desired, a brush can be used for cleaning the finger; brushing during washing can increase blood circulation in the finger. Once washed, the finger must not be allowed to come into contact with any surface, including the child's other fingers. The finger to be punctured (often the middle finger) must be free of any visible infection or prewound; it should be massaged to increase circulation before being punctured with the lancet. This can be accomplished during or after washing.

Steps for Preparing the Child's Finger

1. Select examination gloves. If necessary, rinse them to remove powder.
2. Wash the child's hands thoroughly with soap and water, and then dry them with an appropriate towel.
3. Grasp the finger that has been selected for puncture between your thumb and index finger with the palm of the child's hand facing up.
4. If not done during washing, massage the fleshy portion of the finger gently.
5. Clean the ball or pad of the finger to be punctured with the alcohol swab. Dry the fingertip using the sterile gauze or cotton ball.
6. Apply the silicone barrier. If a spray is used, shake the can vigorously to mix the contents. Direct the spray away from child and collector. Silicone does not dry, and the finger can be punctured immediately.

D. PUNCTURING OF THE FINGER AND FORMING DROPS OF BLOOD

1. Grasp the finger and quickly puncture it with a sterile lancet in a position slightly lateral of the center of the fingertip.
2. Wipe off the first droplet of blood with the sterile gauze or cotton ball.
3. If blood flow is inadequate, gently message the proximal portion of the finger and then press

firmly on the distal joint of the finger. A well-beaded drop of blood should form at the puncture site. 4. Do not let the blood run down the finger or onto the fingernail.

After the finger is ready, the puncture and subsequent steps of forming a drop of blood and filling the collection container should be performed quickly and efficiently, since any delay can make collection more difficult (for example, the blood may clot or the child may resist). Several types of lancets are suitable for puncturing children's fingers. The range from small manual lancet blades to spring-loaded assemblies. Regardless of the lancet used, the puncture should be made swiftly and cleanly and should be deep enough to allow adequate flow.

The site of the puncture should be slightly lateral to the ball of the finger. This region is generally less calloused, which makes puncturing easier and, possibly less painful. The first drop of blood contains tissue fluids that will produce inaccurate results; it should be removed with a sterile gauze or cotton ball.

A barrier material such as silicone will help a distinct "bead" of blood to form, which aids collection. Blood that runs down the finger or around the fingernail is no longer suitable. Blood flows better if the punctured finger is kept lower than the heart. Inadequate blood flow can be improved by gently massaging the proximal portion of the finger in a distal direction, then pressing firmly at the distal joint of the punctured finger (restricting blood flow out of the fingertip) and gently squeezing the sides of the fingertip. Excessive squeezing will cause tissue fluid to be expressed, and the fluid will compromise specimen integrity. Do not let the blood run down the finger or fingernail.

APPENDIX 2

APPENDIX 2

SAMPLE LETTER FOR MFH RESIDENTS

FROM: CC

SUBJ: Lead-Based Paint Awareness

TO: MILITARY FAMILY HOUSING RESIDENTS

1. As part of the Air Force Lead Abatement Plan, Green AFB is taking an aggressive role in making sure that any lead problem areas on this installation are identified and resolved.

2. Lead poisoning, a disease caused by swallowing or inhaling dust containing lead, affects children in nearly all parts of the United States. Young children exposed to paint chips or dust are at higher risk than adults from lead poisoning because of their lower body weight, developing nervous system, and greater tendency to ingest paint.

3. Paints applied to buildings before 1978 contained large amounts of lead. The Consumer Products Safety Act that year restricted the amount of lead in paints manufactured after 27 Feb 1978 for sale directly to consumers. The act also restricted the amount of lead in paints to be used in residences, schools, hospitals, parks, playgrounds, public buildings, and other areas where consumers have direct access to painted surfaces in nonindustrial facilities. Allowing two more years for stocks to be depleted, the Air Force used 1980 as a transition year. Lead in paints used in industrial facilities has never been restricted by federal law; however, it is restricted by Air Force policy.

4. Children who live in old, poorly maintained housing, or in housing undergoing renovation face the greatest risk. There are also many other sources of lead from the environment, from contaminated water and soil due to industrial pollution, and discarded battery casings.

5. Although chances are slim that a brief encounter with one of the environmental risks could have an adverse effect, parents should know what symptoms to look for. Low levels of poisoning may not have any visible affects on children. But, some studies indicate that low levels of lead: may damage the nervous system, including the brain; interfere with growth; harm hearing; lower IQ scores; and make learning difficult. Low-level lead poisoning may also cause behavioral problems like: excitability; inability to concentrate; and frequent emotional outbursts. There are usually no signs of lead poisoning, or they may be mistaken for symptoms of flu or other illnesses. If present, symptoms may include stomachache and cramps, irritability, fatigue, frequent vomiting, constipation, headache, sleep disorders, and poor appetite. As more lead accumulates, clumsiness, weakness, and loss of recently acquired skills can occur.

6. Air Force teams are actively identifying and testing military family housing units and other base facilities that may be affected. If lead paint is found in your home, take the following steps to protect your family until the danger can be eliminated. Tell everyone--brothers, sisters, baby-sitters of

younger children--to be alert and ensure young children do not chew on painted woodwork or eat paint chips and that they wash their hands before eating. Simply painting over old chipped paint or peeling lead paint won't permanently protect a child--the paint will continue to flake and chip. Also, removing lead paint is extremely dangerous--especially to children and pregnant women. The safest way is to have a qualified professional remove or cover the lead paint.

7. The best way to reduce the threat of ever having lead poisoning is to be aware of what causes it and have the source properly abated. In military family housing, we are working hard to fix the problem. Call us at DSN 240-3214 or 210-536-3214 if you have questions, or suspect a lead-based problem in your quarters.

8. We have attached an informational brochure, "LEAD POISONING AND YOUR CHILDREN," by EPA. Please contact Green AFB Military Public Health Office at 440-0000 for questions on the brochure and other health related issues in general.

APPENDIX 3

APPENDIX 3

SAMPLE NEWSPAPER ARTICLE

As part of the Air Force lead abatement plan, _____ AFB is taking an aggressive role in making sure that any lead problem areas on ______ AFB are identified and resolved.

Lead poisoning, a disease caused by swallowing or inhaling dust containing lead, affects children in nearly all parts of the United States.

Young children exposed to paint chips or dust are at higher risk than adults for lead poisoning because of their lower body weight, developing nervous system, and greater tendency to ingest paint.

Paints applied to buildings before 1978 contained large amounts of lead. The Consumer Products Safety Act that year restricted the amount of lead in paints manufactured after Feb 27, 1978, for sale directly to consumers. The act also restricted the amount of lead in paints to be used in residences, schools, hospitals, parks, playgrounds, public buildings, and other areas where consumers have direct access to painted surfaces in nonindustrial facilities. Allowing two more years for stocks to be depleted, the Air Force used 1980 as a transition year.

Lead in paints used in industrial facilities was--and is still today--not restricted by federal law "*BUT IS* restricted by Air Force policy.

Children who live in old, poorly maintained housing or in housing undergoing renovation face the greatest risk. There are also many other sources of lead from the environment, from contaminated water and soil due to industrial pollution, and discarded battery casings.

Although chances are slim that a brief encounter with one of the environmental risks could have an adverse effect, parents should know what symptoms to look for.

Low-levels of poisoning may not have any visible effects on children. But, some studies indicate that low levels of lead may: damage the nervous system, including the brain; interfere with growth; harm hearing; lower IQ scores; and make learning difficult.

Low level lead poisoning may also cause behavioral problems like: excitability; inability to concentrate; and frequent emotional outbursts.

There are usually no signs of lead poisoning, or they may be mistaken for symptoms of flu or other illnesses. If present, symptoms may include stomachache and cramps, irritability, fatigue, frequent vomiting, constipation, headache, sleep disorders, and poor appetite. As more lead accumulates, clumsiness, weakness, and loss of recently acquired skills can occur.

Air Force teams are actively identifying and testing military family housing units and other base facilities that may be affected.

If lead paint is found in your home, take the following steps to protect your family until the danger can be eliminated. Tell everyone--older brothers, sisters, and baby-sitters of younger children--to be alert and ensure young children do not chew on painted woodwork or eat paint chips and that they wash their hands before eating.

Removing lead paint is extremely dangerous--especially to children and pregnant women. The safest way is to have a qualified professional remove or cover the lead paint.

The best way to reduce the threat of ever having lead poisoning is to be aware of what causes it and notify a trained professional when you suspect a lead paint hazard.

APPENDIX 4

Appendix 4

Example Permit Letter

Note: This example permit application is provided to assist the applicant in obtaining a permit. The USAF RIC does not endorse the use of fill-in-the blank or boiler plate applications. The USAF RIC will review and respond to each application based on the representations contained in that application.

FROM: (Person/Address Accomplishing Permit Application)

SUBJ: Radioactive Material Permit Request, Scitec MAP XRF Spectrum Analyzer

TO: MAJCOM/SGPB
HQ AFMOA/SGPR
IN TURN

1. Request a radioactive material permit for the Scitec MAP XRF Spectrum Analyzer IAW AFR 161-16. The required information per AFR 161-16, para 8j:

a. Specific Device Description and Use: Scitec MAP XRF Spectrum Analyzer, containing 40 millicuries of Cobalt-57, for quantitatively determining the amount of lead in paint and soil.

b. Applicant: (Using Organization's Name/Office Symbol/Mailing Address).

c. The device will be used under the supervision of (Name/Grade/Duty Title).

d. The permit RSO is: (Name/Grade/Office Symbol).

e. Qualifications:

(1) The permit RSO has attended the Bioenvironmental Engineering Course, B3OZY9121-000, Brooks AFB, TX. Curriculum Vitae for the Permit RSO, showing applicable radiation experience, is provided at Attachment 1.

(2) The designated Supervisor has attended either the Bioenvironmental Engineering Course, B30ZY9121-000 or the Bioenvironmental Engineering Specialist Course, B3AZY90730-001, Brooks AFB, TX, with supplemental training on the device from Scitec (Atch 2).

(3) All users will have attended either the Bioenvironmental Engineer Course, B3OZY9121-000, or the Bioenvironmental Engineering Specialist Course, B3AZY90730-001, Brooks AFB, TX, with supplemental training on the device from the Supervisor using Scitec's Radiation Safety and MAP Spectrum Analyzer Operator Training Seminar Manual and Scitec's Radiation Manual. Training records are retained by the Supervisor.

f. Procedures:

(1) The device will be used in accordance with Scitec's operating instructions. A copy is attached for your information (see Atch 3).

(2) The device will be stored in a secured area when not in use, and inventoried at least monthly by the Supervisor.

(3) In the event of loss or damage, the Supervisor will immediately contact the Permit and Base RSO who will in turn contact the USAF Radioisotope Committee: HQ AFMOA/SGPR, Brooks AFB, TX 78235-5217, DSN 240-3331, Commercial (210) 536-3331. The Supervisor will also notify Scitec, Commercial 1-800-466-5323, as the device has a $3900/yr complete maintenance contract.

(4) For disposal, the device will either be returned to Scitec or an authorized recipient; i.e., specific NRC licensee or USAF Permittee.

g. Personnel operating this device will be entered on the USAF Personnel Dosimetry Program.

h. Equipment and Radiation Detection Instruments: (Note: Available gamma/x-ray detection instruments may vary from base to base.)

(1) AN/PDR-27T: Calibrated per the instructions contained in T.O. 11H4-7-3-201 every 360 days. Operational checks of this instrument will be performed every 28 days and before each use. The operational check is performed with a Cesium-137 check source provided with the instrument. (State the number of instruments on hand.)

(2) Victoreen 471RF: Calibrated through contract by the manufacturer on an annual basis. Operational check is performed before each use. The Cesium-137 source from the AN/PDR-27T will be used to perform the operational check. (State the number of instruments on hand.)

i. Description of Facilities: The device will be used throughout the base and possibly at other installations if a lead survey is requested. Attachment 4 shows the device's storage location in Bldg ____, Rm ____, and associated measured radiation exposure rates. Personnel working around the stored source will not be exposed to greater than 2 mR in any one hour, 100 mR in any seven consecutive days or 500 mR per year. The storage area will be considered unrestricted.

j. Leak testing will be performed every 6 months by swipe testing the device per Scitec and T.O. 00-110N-3 instructions. The swipes will be sent to AL/OEBA, Brooks AFB, TX 78235-5114 for analysis. Swipe results will be kept in a log.

k. All actions involving the Scitec MAP XRF Spectrum Analyzer will be governed by the following regulations, techincal orders, and instructions: AFR 161-16, (Applicable Base Regulations), T.O. 00-110N-2, T.O. 00-110N-3, and the Operations Manual for the Scitec MAP XRF Spectrum Analyzer.

l. Duty-to-Report Certification letters for the Permit RSO, Supervisor, and current users are provided at Attachment 5. (In regard to Atch 5, only the permitee (applicant) and the designated RSO/Supervisor need to provide these forms.)

PERMITTEE'S SIGNATURE BLOCK
(Normally Hospital Commander)

5 Atch
1. Permit RSO Curriculum Vitae
2. Supervisor Training Cert.
3. Scitec Operators Manual
4. Storage Area Survey
5. Duty-to-Report Certifications

APPENDIX 5

APPENDIX 5

Paint Chip Sample Collection Procedures

Equipment list

- Heat gun
- Two putty knives, one wide and one narrow
- Clean, see-through plastic bags with zip-lock mechanism
- Masking tape or labels
- Permanent marker, not water based
- Sharp, durable, cutting knife with a fine edge or scalpel blade
- Two-handed paint scraper may be necessary to scrape down to the bare substrate when removing for XRF substrate corrections
- Tray or debris catching device
- Prewetted wipes (necessary for cleanup operations)

1. Punching Method

- Apply clear, pressure sensitive adhesive tape over an area slightly larger than the sample to be collected.

- Cut through the paint layers with a punch and template/sharp knife combination of known area.

- Remove all the paint using a sharp chisel having the same dimensions as a side of the square.

- Use the brush or minivacuum to clean the area and dispose of any residual material in a plastic disposal bag.

Samples collected in this manner are for analysis results which are planned to be reported in units of weights of lead per unit area (mg/cm^2). If a small amount of substrate is included with the paint sample, it will not affect the results. What is essential is to include <u>all</u> the paint within the known area, and no more, in the sample.

2. Cutting method:

- Using a sharp knife or scalpel, score the area of paint in question to an appropriate size, attempt to lift the paint off by sliding the thin blade along the score and underneath the paint, and remove a section down to the substrate, making sure all layers of paint are intact. Care should be taken to avoid including wood, paper, or plaster in the sample if the analysis results are to be reported in weight of lead as a percent of the weight of the sample.

- Use the brush or minivacuum to clean the area and dispose of any residual material in a plastic disposal bag.

3. Heat gun:

This method utilizes the fact that paint and substrate materials heat and cool at different rates. It does not work well on plaster, works moderately well on concrete, and works very well on steel and wood. This method should be used only in a well ventilated area, because of possible exposure of the inspector to fumes. With practice, an inspector can effect the removal of an entire paint film, down to, but not including the substrate. Materials needed are a heat gun, 2 sharpened putty knives (one wide, one narrow), and a paint scraper. The technique is as follows:

- Direct hot air from the heat gun about 4 to 6 inches from the surface while pressing the edge of the knife into the paint. Don't overheat (in excess of 700°F) or cause smoking, heat gently to soften the paint.

- Heat for a few seconds and cool for a few seconds while gently pressing the knife edge into the paint.

- Use the knife to lift off the paint, scrap the surface with the scraper to remove residual paint, if any.

- Use the brush or minivacuum to clean the area and dispose of any residual material in a plastic disposal bag.

After using either method recheck to ensure that the samples are properly labeled for shipment to the laboratory.

- Place the sample into corresponding prelabeled sample containers (i.e., zip-lock bag, sterile jar, or plastic tube, etc.). Consult with the contract laboratory for specific requirements.

- Use a separate sample container for each paint chip sample.

APPENDIX 6

APPENDIX 6
Lead Dust Wipe Sampling Procedure

Materials:

- Sterile cotton gauze pads, 4" X 4" or nonalcohol baby wipes (consult your laboratory)
- Plastic template (open area 1 ft by 1 ft)
- Measuring tape
- Marking pen
- Disposable gloves
- Distilled water
- Plastic bags, sealable

Procedure:

- Identify the area to be wiped. Use a plastic template with 1 square foot open area when wiping the floor. When windowsills and wells are sampled, measure the length and width of the area to be sampled.

- Put on disposable gloves. Use new gloves for each sample.

- Remove a gauze pad from its protective package and discard.

- Remove another pad and moisten with distilled water (baby wipes require no moistening agent). Add enough water to completely moisten the gauze.

- Remove a third pad, moisten and place into a plastic bag to be submitted to the laboratory as a blank.

- Place the gauze flat on the surface to be sampled. Wipe in a continuous "S" pattern once over the entire area (do not scrub), pressing firmly with the palm of your hand. Repeat at a 90 degree angle to the first pattern. Fold the wipe in half, folding the dust into the wipe. Repeat two more swipes, using the same pad now folded in half, at a 90 degree angle to each other for a total of four swipes over the surface. Attempt to collect visible dust. Fold the wipe in half again, folding the dust into the wipe, and place into a sample plastic bag.

- Record location, condition of surface, area sampled, surface type, and surface material.

- Submit the samples for laboratory analysis.

Notes:

- Use the same amount of pressure when wiping the surface at each sample location.

- There is no federal standard for lead dust. HUD has recommended the following clearance criteria for abatement work in houses;

-- Floors:	200 $\mu g/ft^2$
-- Windowsills:	500 $\mu g/ft^2$
-- Windows Wells:	800 $\mu g/ft^2$

APPENDIX 7

APPENDIX 7

Soil Sampling Procedures

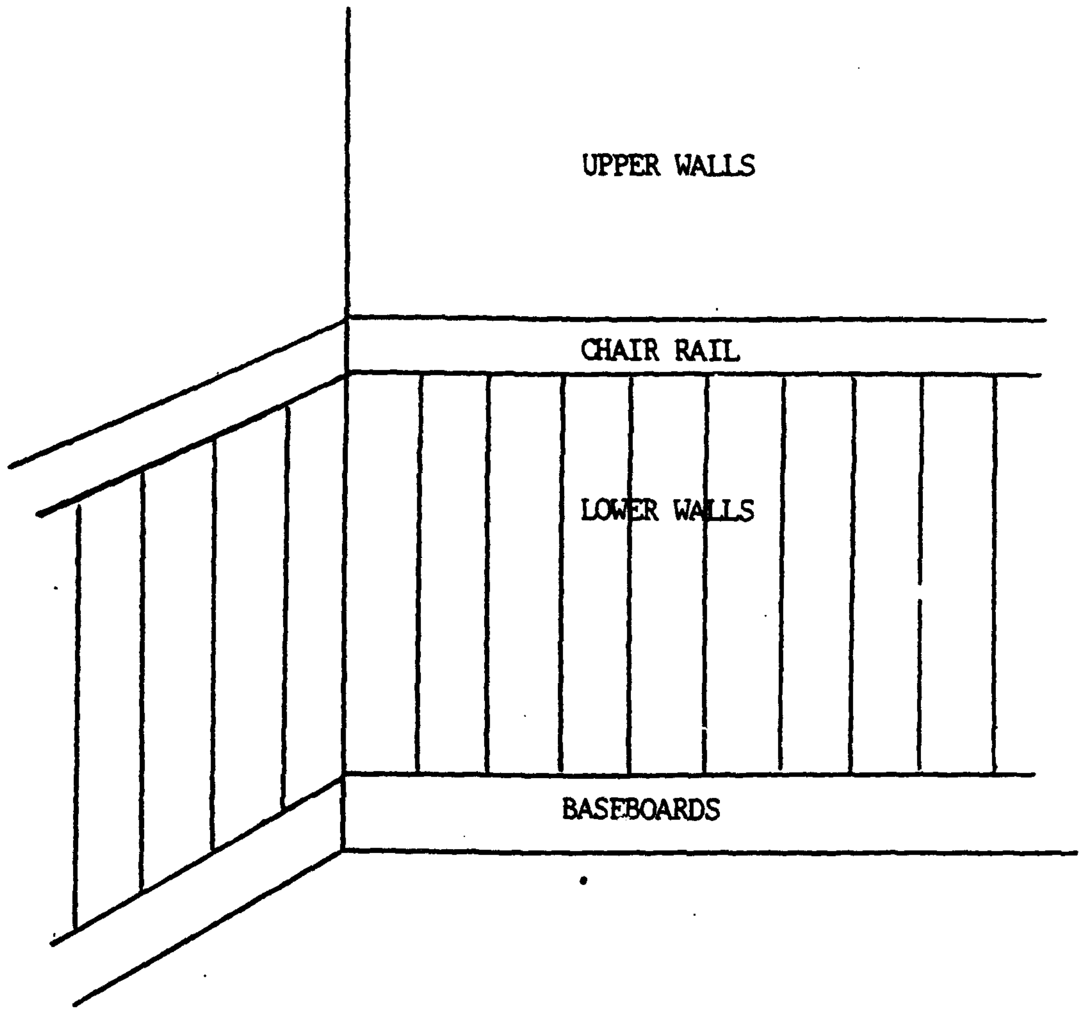
Materials:

- Sterile Gloves
- Spray Bottle w/ DI Water
- Plastic Bags, sealable
- Core Tool
- Measure Tape (preferably 100 Ft)

Procedure:

- Using measure tape, equally portion each side of unit based on the number of samples to be collected.
- Put on disposable gloves. Use new gloves for each sample.
- Collect one core, no more than 3 inches deep, from each location. Ensure to remove large foreign objects that could effect sample results (rocks, vegetation, sticks, paint flakes, etc.). The remainder of extraneous material will be screened in the laboratory.
- Place each of at least three samples into one plastic bag to make a composite sample.
- Ensure core tool is completely cleaned with DI water after sample to prevent cross-contamination.

APPENDIX 8



** Always assume chair rails have been removed

Diagram of Wall Construction Nomenclature

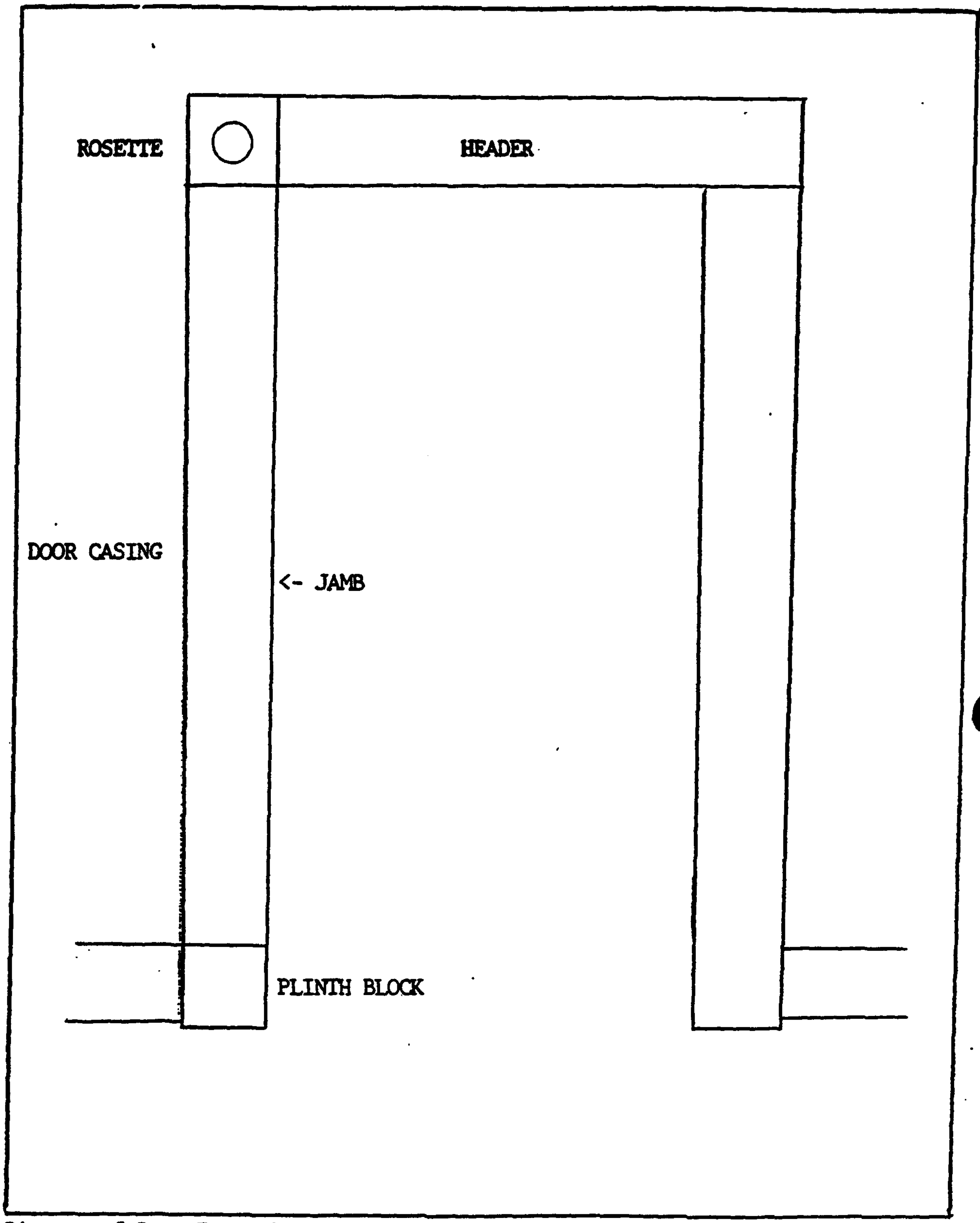


Diagram of Door Frame Construction Nomenclature

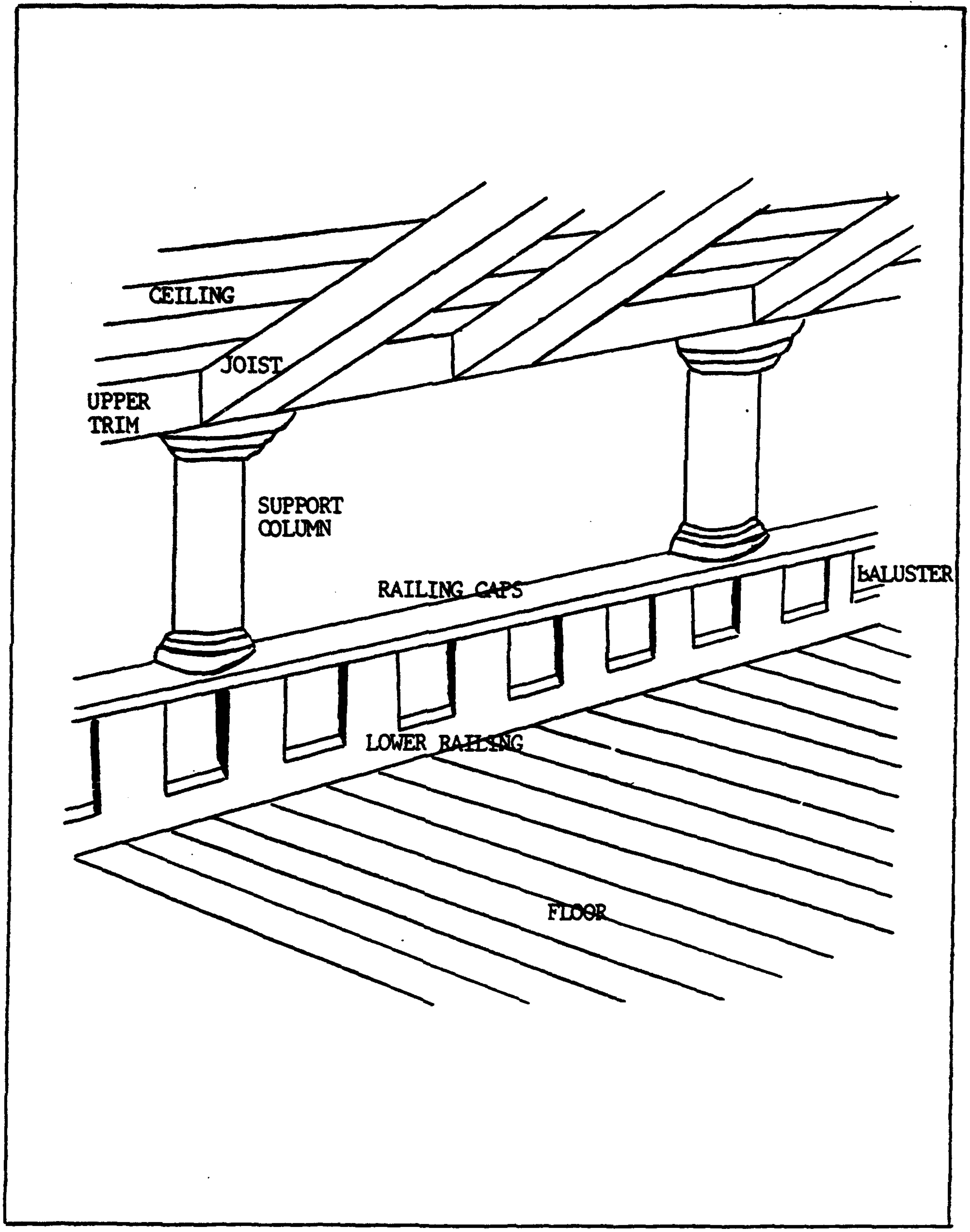


Diagram of Construction Nomenclature

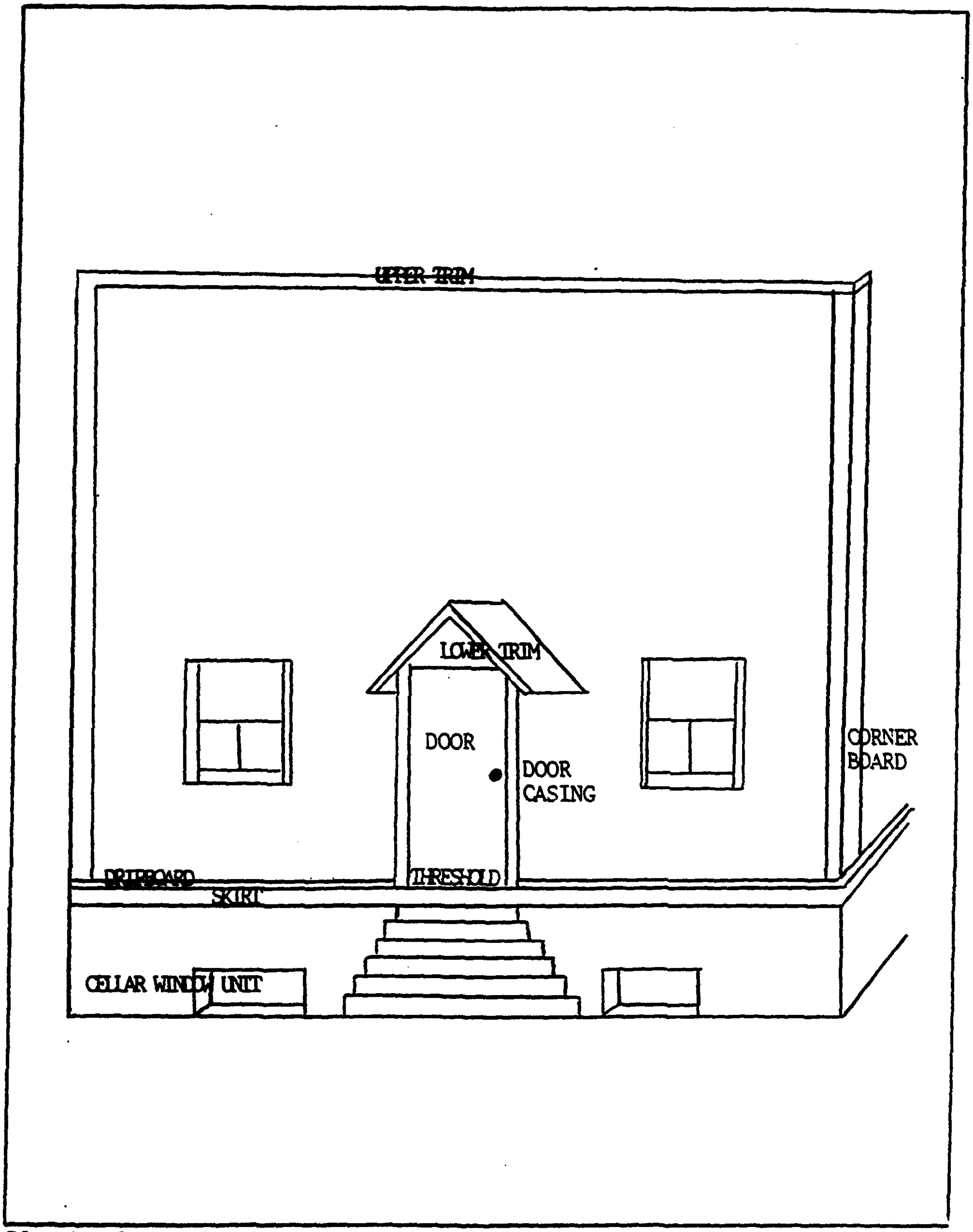


Diagram of Exterior Construction Nomenclature

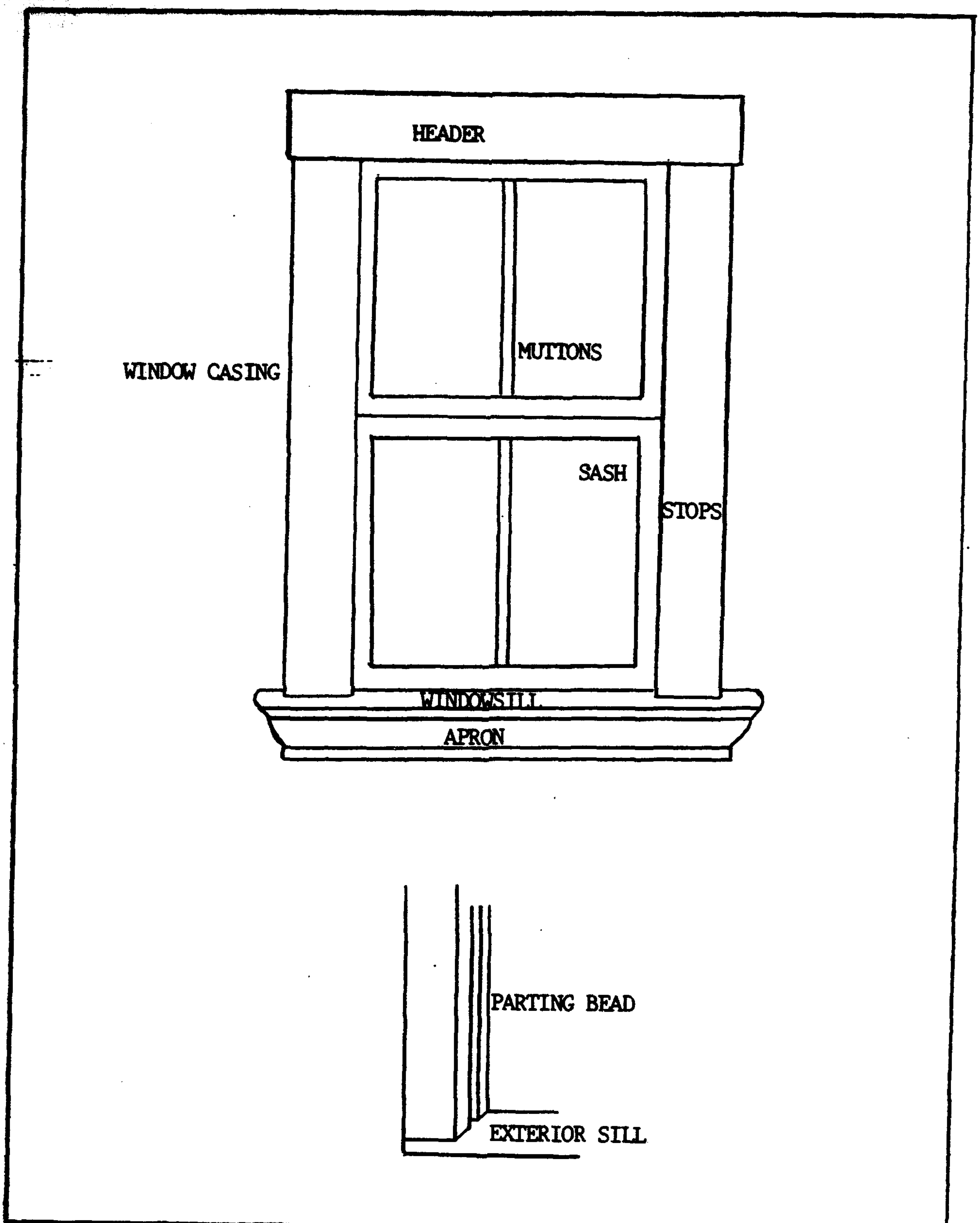


Diagram of Window Construction Nomenclature

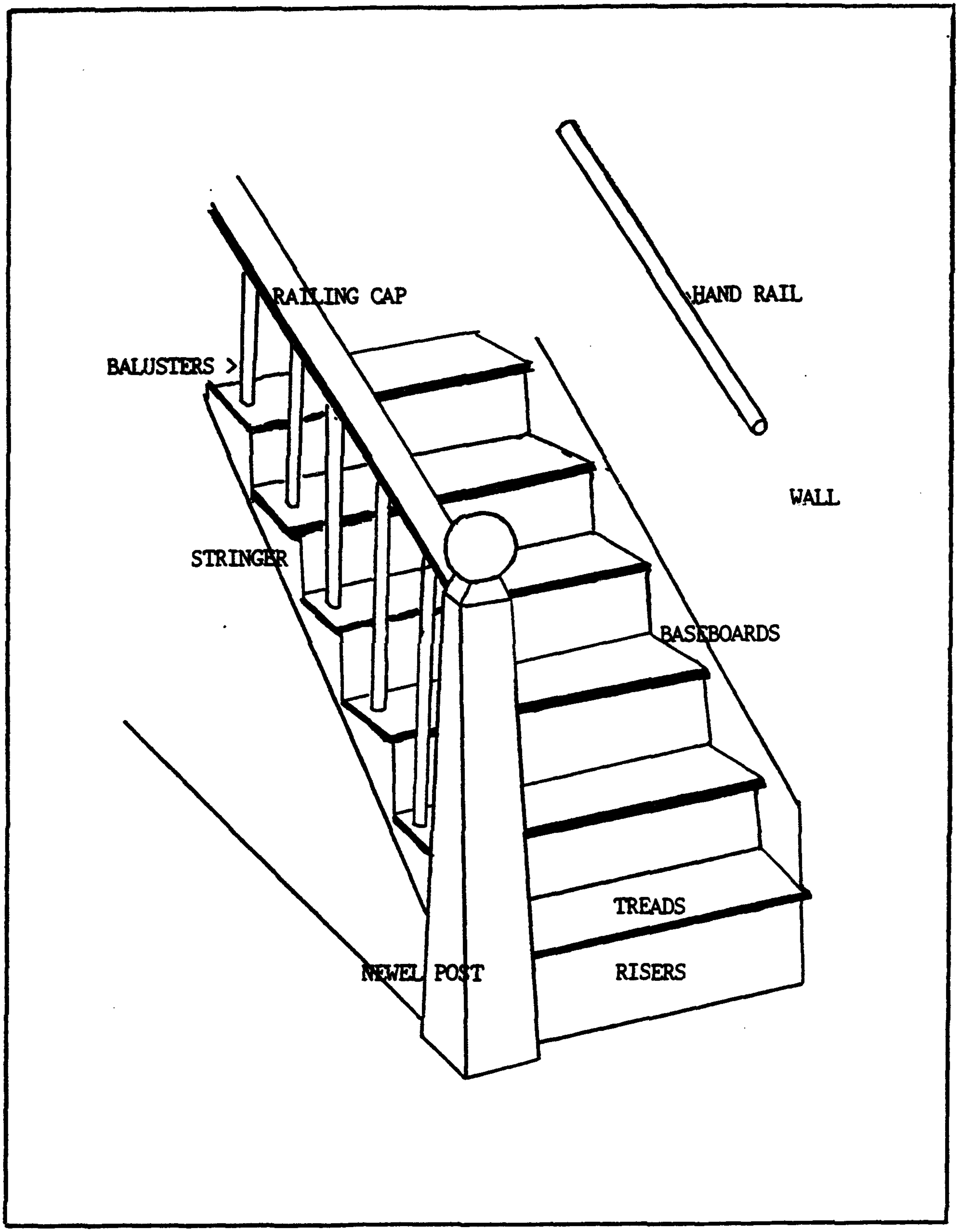


Diagram of Stair Case Construction Nomenclature

APPENDIX 9

Appendix 9

Tabular Summary of Efficacy Factors and Cost Comparisons of Lead-Based Paint Abatement Methods:

ENCAPSULATION

Advantages

- Process is quick and easy
- Abatement contractors require little training for application
- Hazardous waste generated is minimal
- A limited amount of capital equipment is required
- Worker protection requirements are minimal (respirators were required during surface preparation)
- Can be carried out both on interior and exterior of abatement unit
- No additional finish work is required
- Can be applied to almost any substrate type and material with proper surface preparation
- A wide variety of products are currently available on the market
- Works well on hard-to-reach areas
- Generates the lowest levels of airborne dust lead during abatement
- Least expensive of all methods of lead-based paint abatement for all substrates except doors

Disadvantages

- Cannot be used on friction surfaces (e.g., window tracks, door jambs)
- Does not permanently remove the lead-- only covers the hazard
- Cannot be applied during adverse weather conditions
- Long-term effectiveness is unknown
- Bonding to lead-based paint surface is sometimes poor
- Further product testing is required
- Quality of products will vary

ENCLOSURE

Advantages

- When installed properly, this method is a very effective alternative to removing the lead-based paint
- May enhance overall appearance of the room/unit
- Generates very little hazardous waste
- Materials are readily available
- Does not create large amounts of lead dust during abatement
- Provides additional thermal insulation on exterior surfaces
- Works well on large, flat surfaces such as ceilings and walls
- Worker protection requirements are minimal
- Generates very little airborne lead dust during abatement
- Is uniformly more expensive than encapsulating but may be more durable than encapsulation

Disadvantages

- Can only be used on large, flat substrates
- Lead is not removed
- Requires basic carpentry
- Seating is critical and must be carefully examined
- May be difficult to install in older units or over masonry surfaces
- There is a potential for buckling and bellowing if not properly installed
- Can be difficult to install in some instances due to surface irregularities and poor existing substrate integrity

CHEMICAL REMOVAL

Advantages

- Effective on a wide variety of substrate types
- Lead is removed permanently
- Application is not difficult and training is moderate
- Various products are readily available
- Leaves the substrate visually clean when used properly
- Only feasible removal method for exterior walls

Disadvantages

- Labor-intensive and requires time for compounds to react
- Very messy--care must be taken to contain the caustic stripper
- Worker protection is especially important
- Waste generated is considered hazardous
- Large potential for damage to surrounding substrates
- If not used properly, may require several iterations to be completely effective
- Can damage substrate if not used properly by experienced personnel
- Highest failure rates on initial sample clearance tests
- Cleanup is extensive
- Requires a moderate range of temperature
- Creates significant amounts of lead dust with respect to most other abatement methods
- Cost is consistently higher than the costs of removing lead-based paint by hand-scraping or replacement methods

REMOVAL AND REPLACEMENT

Advantages

- A new clean substrate results
- Completely abates the lead and hazard
- Can be used on almost all substrates
- Generally improves the quality of a unit
- Does not create significant hazardous waste
- Most promising of the removai methods
- Relatively little airborne lead dust is generated
- Least expensive of the removal methods on most substrates except for windows

Disadvantages

- Should not be used where architectural significance will be altered
- Requires skilled tradespeople
- More costly than encapsulation for all substrates except for doors

ABRASIVE REMOVAL

Advantages

- Process leaves substrate clean and in good condition where feasible

Disadvantages

- Often infeasible
- Very labor intensive method--large amounts of dust can be generated, requiring worker protection and extensive cleanup
- Application is limited to flat surfaces only, with widths greater than the device
- Does not work well on many materials such as metal, plaster, glass, or gypsum board
- Hard to use in awkward areas (overhead or corners and other detailed areas)

HAND-SCRAPING REMOVAL WITH A HEAT GUN

Advantages

- Experienced workers can be quick and effective
- Can be used on a variety of surfaces
- Lead-based paint is removed permanently
- Extensive training is not required
- Equipment is inexpensive and readily available
- Less expensive than replacing windows when only interior or exterior surfaces of the windows require abatement

Disadvantages

- Very labor-intensive for those with little or no experience
- Creates large amounts of airborne lead dust, more than any other abatement method, and requires strict worker protection in almost all cases
- Paint residue is considered hazardous
- Should not be used on masonry surfaces or on cold metal surfaces
- Care needs to be taken to prevent over-heating of the substrate that could cause a fire
- More expensive than replacement for most substrates except windows and about the same cost for replacement of baseboards, windowsills, and exterior door frames

APPENDIX 10

Appendix 10

Precleanup Checklist:

- Do you understand the critical importance of cleanup in a lead-paint abatement project?

- Have you scheduled both the daily and final cleanups properly and coordinated them with the other participants in the abatement process?

- Have you obtained the most effective cleaning equipment and materials?

- Do you know how to operate and maintain special cleaning equipment, and do you have directions for the proper use of all cleaning materials?

- Have you carefully studied the step-by-step procedures for both the daily and final cleanups?

- Have you made sure your workers are properly protected during the cleanup processes?

- Have you arranged for surface dust testing at the proper times and for related visual inspections?

- Have you made provisions to contain and store potentially hazardous debris properly?

- Have you properly painted or otherwise sealed all appropriate surfaces?

- Have you kept appropriate records to document your role in the abatement project?

- Have you and your workers been trained and certified (if required by local/state regulations) for lead-paint abatement work?

- Do you understand the clearance criteria to be met prior to reoccupancy?

APPENDIX 11

APPENDIX 11

SAMPLE SITE SAFETY AND HEALTH PLAN (SSHP)

1. Project Description.

a. Background. Refer to the Sampling Protocol for Demolition Debris for details and general background information.

b. Study Objectives. The purpose of this project is to determine if the subject buildings contain lead-based paint (LBP) and establish the appropriate waste classification (solid waste or hazardous waste) for the debris.

c. Anticipated Activities. The activities which are to be conducted as part of this study will chiefly involve drilling into structural materials of the subject buildings. Since electrical power is/is not available at the site, a portable generator is/is not available/ may be required to be brought on site for use. (Fill in the blanks with the appropriate terms.)

d. Number of Personnel Required Onsite. At least two persons will be onsite during all sampling activities.

2. TRAINING AND INFORMATION. Personnel performing these sampling tasks will be properly trained to use the equipment, informed of the potential dangers, and provided with the necessary tools to adequately protect themselves. As a minimum, "properly trained" will constitute receiving the Air Force Hazardous Waste Management Training course (copy is usually available in Base EM/environmental flight) as addressed in AFP 32-7042, Chapter 8.

3. HAZARD ANALYSIS.

a. Hazardous Substances. Since it has been confirmed that lead-based paint is present on the building material, lead is considered to be a potential hazard. Where asbestos has been removed from the buildings, there is still a possibility of asbestos fibers in some of the transite boarding and insulation. Care will be taken to minimize any disturbance of these items. In addition, address any other specific hazards or environmental problems in the building (i.e., PCB transformer, etc.) that may pose chemical or physical problems. Make this section specific to your base or location.

b. Exposure Routes. The potential routes of exposure include ingestion, dermal, and inhalation pathways. Ingestion exposures will be minimized by prohibiting eating, gum chewing, drinking, smoking (or using tobacco products of any kind), or applying cosmetics while onsite. Dermal contact will be prevented by personnel wearing protective gloves (and in some cases coveralls). Inhalation exposure is a potential problem since drilling operations may create a lot of dust. The following respiratory protection devices will/may be worn: fill in as needed. (Until the worker exposure conditions are fully characterized, and at the discretion of the Chief, BES, it may be necessary to wear an approved respiratory protection device during bulk LBP sampling. It is recommended that Compliance Air Sampling be conducted on the personnel collecting the environmental samples IAW AFOSH Std 161-8, Air Force Occupational Exposure Levels, to ensure

compliance with 29 CFR 1926.62, Lead Exposure in the Construction Industry, effective date, 3 June 1993.

c. Additional Hazards. Additional hazards include possible physical hazards associated with using the drilling equipment. Only trained personnel will be permitted to use such equipment. Also, sampling personnel will ensure that both electrical and water systems are turned off before sampling.

4. PERSONAL PROTECTIVE EQUIPMENT. The level of personal protective equipment (PPE) necessary for field work on this project is categorized as a modified EPA/OSHA Level D (Ref. 29 CFR 1910.120),which includes safety goggles, gloves, steel-toed shoes, long-sleeved shirts, and pants (BDU or equivalent), with optional tyvek protective coveralls. Appropriate half/full face respirators may be worn as described in the previous section.

5. SITE CONTROL. Site control will be exercised during sampling for this project to protect worker health and safety, and to prevent the spread of potential contamination (lead dust) offsite. Emergency communications with offsite personnel will be by installation telephones located near each site, by messenger, or by radio communication. The following site procedures will also be used:

a. The buddy system will be used. Each worker will act as a safety backup to his/her partner. Offsite personnel will be available for backup/emergency assistance. All personnel will be aware of dangerous situations that may develop.

b. Contact lenses will not be worn during drilling operations.

c. Eating will not be allowed at the site.

6. DECONTAMINATION. Personnel and equipment contact with potentially contaminated materials will be kept to a minimum. Only gloves and tyvek suits will normally be required for disposal. Other dusty clothing will be brushed off at the sampling site and workers will be instructed to wash hands and face directly after leaving the site. The drill bit used to extract the samples will be decontaminated with brushing and double rinsing with tap and then distilled water.

7. EMERGENCY PROCEDURES. All sampling personnel will be informed of the appropriate procedures to follow in case of an accident. Telephone numbers and/or directions to emergency personnel will be provided prior to sampling operations.